5.06(945)A
9

FOR THE PEOPLE
FOR EDVCATION
FOR SCIENCE

LIBRARY
OF
THE AMERICAN MUSEUM
OF
NATURAL HISTORY

Bound at
A. M. N. H.
1910

10-4-3607, Sept 17

TRANSACTIONS

AND

PROCEEDINGS

OF THE

Royal Society of Victoria.

PART I.—VOL. IX.

(For Contents see. Pt. 2 pg. 77)

Edited under the Authority of the Council of the Society,

BY

THE HONORARY SECRETARY, THOMAS H. RAWLINGS.

THE AUTHORS OF THE SEVERAL PAPERS ARE SOLELY RESPONSIBLE FOR THE SOUNDNESS OF THE OPINIONS GIVEN AND FOR THE ACCURACY OF THE STATEMENTS MADE THEREIN.

MELBOURNE:
STILLWELL & KNIGHT, PRINTERS, 78, COLLINS STREET EAST.
Issued July 1868.

AGENTS TO THE SOCIETY.
WILLIAMS AND NORGATE, 14, HENRIETTA STREET, COVENT GARDEN, LONDON.
To whom communications for transmission to the Royal Society of Victoria from all parts of Europe should be sent.

Royal Society of Victoria.

Office Bearers, 1868.

Patron.

HIS EXCELLENCY SIR J. H. T. MANNERS SUTTON, K.C.B.

President.

R. L. J. ELLERY, Esq., F.R.A.S., &c.

Vice-Presidents.

A. K. SMITH, Esq., C.E. | Prof. G. B. HALFORD.

Hon. Secretary.

THOMAS H. RAWLINGS, Esq.

Hon. Treasurer.

ROBERT WILLAN, Esq.

Hon. Librarian.

J. E. NEILD, Esq., M.D.

Hon. Curator.

THOS. HARRISON, Esq.

Members of Council.

Dr. BARKER.
W. GILLBEE, Esq., M.R.C.S.
*THOS. HIGINBOTHAM, Esq., C.E.
*CAPT. J. H. KAY, R.N.
C. W. LIGAR, Esq.
PROFESSOR F. M'COY, F.G.S., &c.
S. McGOWAN, Esq.
J. C. NEWBERY, Esq.
H. K. RUSDEN, Esq.
H. A. THOMPSON, Esq.
ED. WILD, Esq.
PROFESSOR W. P. WILSON, M.A., &
J. B. WERE, Esq.
W. WALKER, Esq.

* Mr. Higinbotham and Capt. Kay were elected 26th March, 1868, in lace of Messrs. Were and Walker.

TRANSACTIONS

OF THE

Royal Society of Victoria.

Anniversary Address of the President,

MR. R. L. J. ELLERY, F.R.A.S., Government Astronomer.

[Delivered to the Members of the Royal Society, at the Anniversary Meeting, held on the 26th March, 1868.

GENTLEMEN OF THE ROYAL SOCIETY OF VICTORIA,

For the third time it devolves upon me, as your President, to deliver the Annual Address, on this occasion inaugurating our thirteenth session.

The honour you have thus conferred upon me was, I confess, an unexpected one; I beg however to assure you most earnestly, that I am fully sensible of the distinction implied in your trust, and no less of the responsibility which it entails.

On similar occasions it has been our custom to review the Society's operations during the previous session, touching also on the scientific progress of our public scientific institutions during the past year. Adopting our usual plan, I now propose to briefly review, first, the contributions laid before you at your various meetings during your last session, following this by a general survey of the year's history of our scientific departments, and concluding with a brief notice of one or

two of the more salient points of scientific discovery belonging to the year 1867 ; for the scientific institutions of the Colony derive so much strength and direction from the work done at the older centres of learning, that no review of our progress is, I conceive, adequately represented without some reference to the general progress of human knowledge.

If, in referring to the work of our past session I appear to dwell unduly upon some of the subjects which have occupied your attention, I ask you to follow me in regarding them as of more than usual interest and importance, and on that account claiming a more detailed consideration.

During our last session we held eleven ordinary meetings. The papers and the discussions following the reading of them were generally of great interest and importance, doubtless aiding us in our advance in the departments of knowledge to which they belong. By the indefatigable zeal of your honorary secretary, Mr. Thomas H. Rawlings, the whole of the last year's Transactions have been printed, and were placed in your hands shortly after the close of the year, and also distributed to the various learned societies with which we are in communication.

Of the contributions laid before you, two pertain to physical science, three to the natural history of Australia, three to the development of our natural resources, two to pathological science, four to the geology, mineralogy, and palæontology of Australia and New Zealand, one to social science, and two to applied chemistry.

I will first refer to the Rev. J. E. Tenison Wood's paper "On the Glacial Period of Australia," in which he gives his reasons for concluding that "during the Glacial period of Europe our continent and seas have passed through a subtropical climate," or at least a much warmer one than we now experience. He stated, as you well remember, that he did not base his

opinion upon the absence of those groovings and striations left by the mighty slip of glaciers and icebergs—for in the northern hemisphere these are not found lower than the 40th parallel of latitude—but rather upon the subtropical character of our tertiary fauna; he concluded his paper by saying, "A true glacial epoch in New Zealand would be a puzzling fact, and very difficult to reconcile with what we see in Australia," and stating his belief that the Australian continent is now passing through a colder period than any of which we can find evidence in its previous geological history. On the same subject, and discussing these views, Dr. Haast, an honorary member of this Society and geologist to the Province of Canterbury, New Zealand, contributed a paper, which was read at the October meeting. Referring to Mr. Wood's paper, he stated that he had traced glacial action over the whole length and breadth of the south island of New Zealand; he does not accept Mr. Wood's conclusion, with respect to the non-existence of evidence indicative of our continent having passed through a glacial period, and points out that if geologists want to find traces of this epoch they must look for it in the Australian Alps, where morainic accumulation may have been preserved around the lakes; but from the small altitude of this chain, he expects these will be of small extent and dimensions.

Mr. Thompson read a paper "On the Formation of Mineral Veins and the Deposit of Metallic Ores and Metals in them," at our October meeting. In the present stage of our knowledge of geological changes, the mode of occurrence of minerals in veins and the formation of the latter, present almost insuperable difficulties to the clear comprehension of them. This subject, although it has taxed the energies of Hopkins, Bischoff, and other superior minds, may be considered as still unsolved. In Mr. Thompson's paper, his conclusions are based upon observations of particular cases,

and are thus preferable to geological conceptions of a purely speculative character.

Professor M'Coy, at the February meeting, announced the discovery in Australia of *Enaliosauria* and other cretaceous fossils, thus establishing the fact—of immense geological importance—of the existence of the cretaceous period on the Australian continent.

A description of a fine specimen of rubellite or red tourmalin, found for the first time in Victoria in a mine at Maldon, was read by the Rev. Dr. Bleasdale, at our July meeting.

An account of some bone-caves at Glenorchy, in Tasmania, contributed by Mr. Wintle, of Hobart Town, was also read on the same evening.

Turning to the papers having reference to natural history. At the first meeting of the session, Professor M'Coy described three new species of Victorian birds, and at the September meeting he contributed a paper "On the Species of Wombats," in which he showed us that until very recently only one species of wombat was known to zoologists, The Phascolomys wombat, but that the existence of four species, which he described, may now be considered as demonstrated.

At the meeting in May, an elaborate paper "On the Australian Coleoptera," was presented to the Society by that renowned naturalist, Count de Castelnau. It contains descriptions of a large number of new Australian beetles, and forms a most valuable contribution to entomological science.

Of the two papers which I have classed as pertaining to physical science, one was read at the February meeting, by Mr. G. W. Groves, and was entitled "Contributions to Meteorology." The other was a description of a new self-registering electrometer, which I had the honour of reading at the last meeting of the session. This description referred

to an apparatus I had devised and erected at the Observatory, for the purpose of obtaining a continuous record by the help of photography, of the force and variations of atmospheric electricity. Specimens of the photographic curves it produced were also exhibited. You will be glad to hear that after experience of its performance, we have every reason to consider it a most useful addition to the meteorological appliances of the Observatory.

Some valuable contributions, bearing on the development of our natural resources, were read at the April, May, and October meetings, the first of which is "On the Manufacture of Paper from Native Plants," by Mr. Newbery, in which he drew our attention to the importance to be attached to the discovery of raw material suited to paper making, and pointed out that we had several indigenous plants fitted for this purpose growing in considerable profusion on our waste lands; he especially called attention to two grasses, the *Xerotes Longifolio* and a variety of *Lepidosperma*, the fibre of both of which he believed would be of great value for making common paper, and for mixing with rags for white paper. Mr. Newbery's valuable suggestion will, no doubt, be practically tested so soon as the new paper mills on the Yarra commence operations.

The second communication of this class was a paper "On Colonial Wines," by the Rev. Dr. Bleasdale. This placed before you a large amount of practical information respecting our vineyards and the wines produced from them. He gave the results of his chemical inquiries into several samples, and indicated the conditions on which he considered the success of Australian wine-making to depend.

Mr. Newbery's paper "On the Analysis of our Mineral Waters," forms another contribution bearing on our natural resources. The writer gives the analyses he has made of the waters from several of our quartz mines remark-

able for containing a large per centage of chloride of potassium, as well as of the Ballan springs, the latter found to contain a large per centage of carbonate of soda, with carbonate of lime and magnesia, with 416 cubic inches per gallon of free carbonic acid. This water, as you are aware, has now come into extensive use under the name of "Ballan Seltzer Water;" it forms a very refreshing and pleasant beverage, and may, no doubt, be medicinally useful in some cases.

At the June meeting, Professor Halford brought before us his paper "On the Appearances of the Blood after Death by Snake Poisoning." At the October meeting also, he contributed some further observations on the same subject.

You will remember that in April last, a gentleman died in Melbourne from the bite of a cobra-di-capella, which he had brought from India, and thought to be fangless. At the *post mortem* examination, Professor Halford, remarking the great fluidity of the blood, examined some under the microscope, when it appeared to him to contain a great number of colourless cells of a larger size than any usually seen in blood. Further examination corroborated this fact; he observed numerous cells much larger than blood corpuscles, with delicate translucent cell-walls, each cell containing one, two, or more nuclei, and also noted a peculiar macula or nipple on the cell wall after the application of magenta dye. He killed a dog with poison taken from the glands of the same cobra, and other animals with poison taken from Australian snakes, and after death in every case the blood was found fluid and full of these cells. By later observations he was led to believe that the growth of these cells commences immediately the poison gets into the blood, and continues to grow even after death; so that twelve hours after death blood taken from an animal that died from the poison in ten minutes, will be in the same stage as regards the cell growth

as that taken one hour after death from an animal that survived the poison eleven hours.

Considering the importance of this subject, I make no apology for troubling you with a succinct account of my personal experience concerning Professor Halford's discovery. Some little time since, I had, in company with a friend, a good observer with the microscope, an opportunity of witnessing the progress of this cell growth. A dog bitten by an Australian tiger snake at 9 a.m., died in an hour; at 3 o'clock some blood taken from a vein was dark and quite fluid. Under the microscope the red and white corpuscles appeared normal in size and shape, but were moving about free in the fluid *liquor sanguinis*, and not sticking together in rouleaus, as is usual with healthy blood. Amongst these corpuscles we observed spaces where some apparently structureless granular matter had pushed them aside. An hour after a fresh supply of blood from another vein showed us amongst what appeared to be the same kind of granular matter, large nucleated cells, which we estimated to be from three to four times the diameter of the ordinary red corpuscle; these cells, whose walls were so delicate and translucent that it required most careful management of the light for their definition contained nuclei, some, one, many with two, three, or even more; delicate as they were, however, they became as distinct as the ordinary red corpuscle by the application of a little magenta dye, which did not seem to alter their dimensions in the least by osmotic action. In many of these cells also, the little macula on the cell wall was observed, but not on all. In blood taken from the jugular vein twenty-four hours after death, we observed these cells, now appearing more tense, in immense numbers, and many of the nuclei floating about free, as well as a great quantity of transparent acicular crystals, which magenta dye rendered very distinct.

The existence of cells in the blood of the individual who died from the cobra's poison, different from those found in cases of pyæmia, leucocythæmia, and other diseases, was warmly contested in this Society, and you will remember the animated discussions we had on the subject; but those who have carefully observed the blood in snake-poisoned individuals, cannot, I should imagine, be in the least doubt as to the fact of the presence of these cells. My friend and I were very sceptical on this point, and at first failed to see them, but afterwards we felt no longer any question in our minds either as to their presence or to their size being greater than that of any cells in the blood we had ever witnessed or seen described.

Whether this particular cell-growth is peculiar to snake-poisoned blood, or whether it may be found in the blood after death from other causes, especially in cases where the blood remains fluid, is a question not yet determined, but one that still occupies Professor Halford's attention, and one to which he invites the general attention of microscopists as well worthy of a searching inquiry. He tells us that in most careful observations, repeated very many times, he traces the growth of the cell out of the germinal matter before alluded to; that first the nucleus appears, then the cell wall. This, if established, is an important point, and one upon which many of our greatest physiologists are not agreed. Kolliker and Virchow holding the view that all cell-growth proceeds from pre-existing cells, while Schleiden and Schwāan believed they always grew out of structureless granular matter; Beale, a later authority, working with higher microscopic powers, leans also to this latter view.

Professor Halford considers that snake-poison acts as a kind of ferment in the blood, and that the oxygen which is required to keep it in a condition to support vitality, is used up by the cell-growth, thereby causing the death of the

bitten individual. After death we find the dark fluid blood rapidly absorbs oxygen when exposed to the air, and becomes bright in colour ; the fibrine has also disappeared, or at all events has become so far degraded by some molecular change as to be no longer coagulable.

Although we may regard these investigations as of the highest importance, not only in their direct reference to the question of snake-poisoning and animal poisons generally, as well as to that cell-growth and the study of the chemistry and physiology of of the blood, yet it must be confessed that the great question of saving from death those bitten by snakes is still an unsolved problem ; the light thrown upon the whole subject, however, appears to indicate a path by which the rational treatment of these cases may be arrived at. But little, after all, is known of the functions of the blood or of its connection with nutrition of the tissues and vital force, or of its intricate, chemical, and physical changes in disease; and it is from inquiries of this kind, philosophically conducted, that we must look for progress in this most difficult and at present obscure branch of human knowledge. Such inquiries, however, for their successful pursuit, appear to require not only a knowledge of physiology and pathology, but of the highest chemistry and physics generally—a rare combination to be met with in one individual; and it suggests at once that scientific progress in the treatment of disease will come but slowly, until natural philosophy and chemistry, especially in its dynamical aspect, form as large a part of a medical student's training as even anatomy itself.

Mr. Rusden's paper, " On the Ethics of Opinion,' was read at the September meeting ; it treated of how far men are properly liable to blame or praise, reward or punishment, for their thoughts or actions. The novelty of character of this contribution may have given rise to an impression

that it was not exactly of a nature included within the objects of the Society: very little consideration must however show, that any attempt to contribute to social improvement, so long as it is regarded in its scientific aspect, may be fairly considered to come within the scope of this Society.

"The Danger of Collision between Vessels crossing one another's Tracks," was the title of a communication from Captain Perry, read to you at the November meeting. In this paper a very simple method of procedure to be adopted by approaching vessels was suggested by the writer, by which danger of collision might in nearly all cases be avoided. The plan suggested consists in the approaching ships ascertaining if the same relative bearings between them continues to be maintained, and if so, to alter their course; for, as was demonstrated by a simple diagram, collision becomes inevitable if the same bearing is maintained. So simple a mode of even lessening the probability of collisions, if not already generally adopted by nautical men, should be well noted.

At the same meeting a paper "On the Purification of Water," was presented by Mr. Dahlke. This related to a method of filtration devised by the writer, by which organic and most mineral impurities, including the salts of lead, were removed from drinking water; brackishness also, by a judicious arrangement of this filtering medium, he stated might be removed to a considerable extent. He exhibited a filter that he had constructed which was partly tested in your presence; the further testing of its properties you will remember was referred to Mr. Newbery, who reported at the next meeting that the filter not only did all that Mr. Dalhke had stated, but he found it to possess powers of filtration beyond anything he had previously known; he had tried it very severely by filtering solutions of salt, sulphate

of magnesia, and even sulphate of ammonium with it, and in every case the filtrate passed out as drinkable water, with barely traces of the substance previously in solution. Passing hot water in a reverse way through the filter removed the suspended salts and restored the activity of the filtering medium, which, after continued use, was diminished.

Some experiments were since tried on the filtration of sea-water, by Mr. Dahlke, and I believe he is now engaged in the construction of a large filter for rendering brackish water fit for sheep and cattle at some station on the Darling river. There is no doubt that the kind of filter exhibited is exceedingly successful as an ordinary domestic filter, but whether it will become practically successful in so remarkable a use as that of removing salt from sea or very brackish waters, is not yet demonstrated.

I congratulate you upon these results of your past session, and I regard them as an evidence of increasing activity and an earnest of advancement in the objects of this Society.

You will be glad to learn that our intercourse with kindred societies has increased; there are now eighty-six learned bodies with which we are in communication and interchange of publications; forty-one of these are British, thirty-six Continental European, five American, two Asiatic, and five Colonial. Our library has been considerably increased by donations from these societies, and a complete catalogue, compiled by your honorary librarian, Dr. Neild, is appended to the second part of the last volume of our Transactions.

I would now revert to the year's history and present state of our public scientific departments, and in doing so if I speak at more length of matters concerning our Observatory than of the other institutions, it is only because I am better acquainted with the details of its progress.

In my last address I told you that the Great Southern

Telescope, which by-the-bye is now to be styled the *Great Melbourne Telescope*, was approaching completion, and its arrival might be expected in the course of a few months. It has, however, not yet reached us. Several unlooked for delays in its construction occurred, principally owing to the determination on the part of the manufacturer, Mr. Grubb, that nothing but the very highest excellence in all its parts should go to its construction.

Many of you, no doubt, read the interesting letter of Dr. Robinson, of Armagh, which appeared in the daily papers a week or two since, respecting his inspection and trial of this great instrument, and that he passes a high eulogium on the excellence of its mechanical details, as well as of its optical powers, so far as he was enabled to judge from the imperfect trial he had with it in this respect. We are expecting every mail to hear of its shipment, and there appears to be every probability of its being even now on its way. M. Le Sueur, a gentleman selected by the committee as an observer for this telescope, comes out with it, and will occupy the position of second assistant-astronomer at the Observatory. Of this gentleman's high qualifications for the work before him we have the best testimony. You are aware, no doubt, that apparatus for celestial photography and spectrum analysis of the light of the heavenly bodies will form part of the appliances of this gigantic instrument, and I trust that Dr. Robinson's hope, "that an inestimable harvest of discovery and triumph will crown this magnificent enterprise," will be fully realised. I have obtained a few photographs of a lithograph of the Great Melbourne Telescope, which will be handed to you at the conclusion of this address.

It appears that some kind of a building with movable roof will be necessary to protect it from the great damage likely to arise, if exposed to the dust-storms we are liable to;

it is therefore proposed to erect a circular building, with a revolving roof, and Parliament will be asked for a vote for this purpose. A small extension of the Observatory ground has been granted, thus enabling the telescope to be erected in a position where it will command a full view of the heavens without creating any disturbance on our magnetic instruments by its too close proximity.

You will remember that in my last address I mentioned that a complete set of self-registering magnetic instruments or magnetographs (similar to those used at Kew) were expected to arrive shortly. These duly arrived, they have been erected and at work since November last, producing an uninterrupted photographic record of all changes of the forces of terrestrial magnetism.

A wet and dry bulb thermometer and barometer, continuously self-registering, on the same principle, are now being constructed for us, and will probably be at work in the course of a few months. The results likely to be obtained from the adoption of self-registering instruments of this kind can scarcely be too highly estimated, for the periodic method of observing phenomena that are changing continuously, could never satisfactorily admit of those close deductions being made requisite to derive any practical value from the observations. Variations of the forces measured sufficient to establish or overthrow a supposed law may, and doubtless do, often happen in the intervals between intermittent observation, which, by the photographic or other self-registering method, is indelibly recorded with true relations to preceding and following variations.

The Melbourne portion of the survey of the southern heavens has made considerable progress; the portion of the heavens lying between the 150° 40′ and 152° 46′ parallels of declination have been thoroughly surveyed, and the positions of 19,600 stars established.

A series of observations for the determination of the difference of longitude between Melbourne and Adelaide by aid of the Electric Telegraph, was made at the latter part of last year, and although the result is considered not quite conclusive, as it is intended to make another series of comparisons, it may however be accepted as nearly the truth, and makes the difference of longitude 25m. 33·78s. assuming the longitude of Melbourne to be correct, that of Adelaide would be 9h. 14m. 21·02s.

Before leaving the subject of our astronomical labours, I would add a word concerning the total eclipse of the sun, which will take place on the 17th of August, this year.

The eclipse will be a most remarkable one, and unrivalled by any recorded in the annals of mankind in its magnitude and duration. At its commencement the moon will be unusually near the earth, and at the same time reaches the ascending node of her orbit. The sun also reaches nearly the zenith of those places where the eclipse takes place at noon; the augmentation of the moon's apparent diameter, due to her altitude is a maximum ; a combination of circumstances resulting in the apparent diameter of the moon exceeding that of the sun by an unusual amount, and in the time during which the sun will remain eclipsed, being almost unprecedented.

The greatest length of totality will occur in longitude 102° 38′ E. and 10° 28′ N. in the Gulph of Siam, where it it lasts 6m. 50sec. The path of totality, which commences at sunrise in Abyssinia, passes over the Straits of Babel Mandeb, Aden, Arabia, through India between Goa and Rajapoor, across the Gulph of Siam, where the greatest phase occurs—then through Borneo, the whole of the South of New Guinea, ending at sunset about the New Hebrides.

So unusual an eclipse as this is sufficient to put astronomers on the *qui vive,* for such an one has probably never

been seen by man, and none of such magnitude is likely ever to be witnessed by any now living. But there are, however, higher objects than this in view, and great preparations are being made to carry out investigations concerning the sun's atmosphere, which can only be attempted during total eclipses, and for which this one offers so long a period of totality. It has long been supposed that an atmosphere surrounds the sun's exterior to the photosphere. Those remarkable red clouds or prominences and the corona or glory with its projections, generally seen in total eclipses, and especially in that of 1860, all point to this. These luminous clouds were found by Mr. De la Rue to have great photographic power, and Mr. Brayley concludes therefrom that they probably consist of incandescent globules of metal in a liquid state, or perhaps of solid particles of the metals discovered in the sun by Kirchoff. The optical means of analysing the light from various sources have been so much improved since the last total eclipse witnessed by astronomers in 1860, and our increased knowledge of the physical conditions of the sun, as well as of many other of the heavenly bodies, induces the scientific world to confidently hope that the telescope, spectroscope, and heliograph will reap rich harvests in the hands of the many experienced observers who will be engaged in the path of totality.

The Botanical department, so efficiently conducted by your fellow member, Dr. F. Mueller, has not been idle. The "Fragmenta Phytographa Australis," I am informed, will have reached the completion of the sixth volume next month. Dr. Bentham's new work on the Australian Flora (to which Dr. Mueller contributes largely) is progressing rapidly; the fourth volume containing the Candollian division—Corolliflora—is nearly complete; the fifth volume, which it is expected will be issued next year, will contain the Mono-

chlamydea; and it is intended to follow it up by a sixth volume, containing the Monocotyledons and Ferns. A supplementary volume will afterwards be probably issued, to comprise the newer discoveries amongst cotyledonous plants, for which the "Fragmenta" will afford the principal records. This book will be the most complete descriptive work on the vegetation of Australia, and with which, in its completeness, no similar work on European vegetation can compare. You will be glad to learn that the Cinchona (Peruvian bark) plants are prospering. Dr. Mueller informs me they have been exposed to extremes of temperature, varying from 30° Fahr. last winter, to 100° Fahr. during this summer, in an artificial fern gully in the gardens without injury; this gives ample testimony of their hardihood, and their fitness for coping with the much smaller vicissitudes they would be liable to in the sheltered gullies of our mountain ranges. The establishment of this most valuable plant is of the utmost importance, and in a commercial point of view can scarcely be over-estimated. There are now in the garden nurseries a large number of plants of cork oaks, Western Australia mahogany, tea, tobacco, coffee, and other prominently useful plants, ready for planting in the valleys of the Upper Yarra this autumn.

Dr. Mueller made a botanical visit to Western Australia during last year, and he informs me his principal object was to connect the observations of the flora of that colony with geological formation, in continuation of the many facts he had traced out in other parts of Australia. An investigation of the mutual relations existing between vegetation and geological formations is of great importance as bearing on the general question of the occupation of the soil for various purposes of culture.

The Phyto-chemical laboratory under Dr. Mueller's direction is still engaged in researches into the technological,

medicinal, and other properties of the Australian vegetation, and especially as regards the amount of potash in our trees, which he states has already afforded highly satisfactory results. The question of the yield of iodine and bromine in our large sea weeds is also occupying the attention of this branch of the botanical department.

Our National Museum, under the management of Professor M'Coy, continues to increase in its usefulness. It was highly praised by the naturalists and officers of the Italian Scientific Expedition, who visited us in the *Magenta*, and who were fresh from the study of the best zoological collections in Europe. Our member, Mr. Ulrich, too, who has just returned from an inspection of the principal mining schools of Europe, finds them exceeded by the mining section of our museum, prepared by Professor M'Coy with the object of facilitating the establishment of a School of Mines in the colony by taking advantage of the proximity of the National Museum to the University, in which eight out of the ten courses of lectures required are already given. The natural history specimens mounted eight or ten years ago still maintain their freshness and state of preservation, which is, no doubt, in a great measure attributable to the fact that the Museum is surrounded by the well-planted University grounds, where it is free from the destructive influence of dust and smoke. Various classes of the University students make daily use of the different sections of the Museum, while the number of the general public who visited this institution during the year amounted to 68,000.

Amongst the most interesting colonial specimens added during the year is the great skeleton of a new species of whalebone whale (*Physalus Grayi*, M'Coy), which is now beautifully articulated, and placed outside the west wall of the Museum. This specimen is 90 feet long. Next to this in interest are the further donations of Mr. Carson, of

Eualiosaurian fossil reptiles from the Flinders, to be described in our proceedings as bearing out the views already laid before this Society concerning the occurrence of these fossils in Australia. A very large iron meteorite, from Cranbourne, weighing thirty cwt., has been placed in the Museum, which Professor M'Coy promises to describe to us at an early meeting. Considerable additions, illustrative of foreign natural history, have been made, and the conchological collection, which is of great extent, is now almost completely named.

The geological collection is also largely increased, as well as that of the different *articulata*; but it appears that there is no more room at present in the half of the Museum already built for their display.

From the report of the Government geologist, Mr. Selwyn, just published, we are put in possession of the progress made in the geological survey of the colony. It appears that fifty-five quarto sheets, each of which contains the geological features of fifty-four square miles, have already been published, and that eleven are ready for the engraver. A collection of 1248 geological specimens has been arranged and labelled for the National Museum. Besides the stratographical arrangement of these specimens, each is labelled with numbers and letters, indicating its locality and the map to which it belongs. Considerable additions to the geological sketch-map of the colony have also been made by the director, from his reconnoissance surveys in various districts. The department, however, has been singularly crippled during the past year, owing to the absence of some of the officers on leave, and the sickness of others. The survey has, nevertheless, made considerable progress, especially in the districts of south Ballarat and north of Creswick and Clunes. It appears that a party has been engaged in the first-named locality on a research into the course and limits

of "*deep leads*" of the Ballarat gold-field, which has already resulted in Mr. Murray, the gentleman engaged in this portion of the survey, being enabled to indicate the existence of payable gold deposits in a locality where, though frequently traversed by miners, no workings had been established.

In contemplating the more interesting facts that have marked the progress of science in Europe, our attention is attracted by a recent discovery of paramount significance.

In the spectra of many of the fixed stars the lines proper to hydrogen have been observed, and in the outburst of the light of the star T-Coronæ, some time ago, the development of these lines was so conspicuous as to lead to the inference that an outburst of hydrogen, of the nature of a general volcanic eruption, had taken place in this star. Singularly in agreement with these observations are certain results determined by Dr. Graham during his researches on the occlusion of gases by metals.

This exact chemist has shown that the different metals have properties of their own of condensing the various gases, and concealing or occluding them within their substance. In the case of meteoric iron, he has found that it is not only charged with occluded gases, but that the gases thus enclosed are different in kind from those concealed in iron of telluric origin. Common iron bears the impress of the mode by which it has been manufactured in the large proportion of carbonic oxide and carbonic acid as constituents of the gases stored between its particles: whereas, on the other hand, the iron of the Lenarto Meteorite has yielded abundance of hydrogen gas almost entirely free from gaseous carbon compounds.

On these results, Dr. Graham remarks, "The iron of Lenarto has, no doubt, come from an atmosphere in which hydrogen greatly prevailed. The meteorite may be looked

upon as holding imprisoned within it, and bearing to us, hydrogen from the stars." Speaking of the amount of gas given up by this meteoric iron being three times the amount found in iron of telluric origin, he further says, "The inference is that this meteorite has been extruded from a dense atmosphere of hydrogen gas, for which we must look beyond the light cometary matter floating about within the limits of the solar system."

A few years ago results of this kind would have been deemed almost beyond the hopes of even the most sanguine philosophers. Dr. Graham presents to us in a tangible form the hydrogen brought from remote regions of space to which possibly our most powerful telescopes have yet failed to reach. He demonstrates that it must have come from a dense atmosphere of the gas found; and, what is of still higher interest, his experiments conduce towards the view, that the so-called chemical elements of our world are so framed as to adapt them to uses throughout the entire scheme of nature.

In conclusion, I will for a moment return to the affairs of the Society. There seems to be every prospect of steady progress. I am rejoiced to see the members earnestly following up the objects for which this institution was intended. Our efforts, whether they have for their aim the investigation of the laws of nature, the development of our natural resources, or the alleviation of the sufferings of our fellow-creatures, although, perhaps, crowned with only partial success, have each the effect of promoting our advancement as a people, and of raising the estimate of the intellectual status of this colony in the minds of the intelligent in other parts of the world. In these days no apology for scientific experiment is required, for although the primary object of science is the discovery of truth, it is now universally admitted that the

contributions applied to the arts of life are among the most valued means by which our civilization is advanced. In a new country the problem of the utilisation of its resources opens the widest opportunities for the adaptations of science to practical requirements. An example will illustrate this general assertion: let us for a moment consider our relation with the older countries in reference to the supply and demand of the one important item of animal food. We have inexhaustible means of supply, while in European countries flesh food is becoming yearly scarcer. Any improved method of animal food preservation, assisting its transport, would be a vast accession to our means of wealth, and to this end the facts of chemistry in relation to physiology appear as affording the proper key. The case of food supply is by no means a solitary instance; the same reasoning applies generally to the natural resources of a new and extensive country like Australia.

In these and like considerations let us hope that a sufficient stimulus for our best efforts will be recognized, and that our endeavours will be so far fruitful as to entitle the Royal Society of Victoria to rank in due time with similar older institutions in Europe and America.

ART. I.—*On the Temperature of Solar Radiation, as Measured by the Black Bulb Thermometer.* By Mr. R. L. J. ELLERY, F. R. A. S., Government Astronomer, &c., President of the Royal Society of Victoria.

[Read 24th February, 1868.]

The temperature of solar radiation at the earth's surface, or as it is more commonly known, the "temperature in the sun," is now usually measured by means of a black bulb thermometer fully exposed to the sun's rays, the maximum temperature attained being marked by a self-registering index. These thermometers are now generally enclosed in an outer hermetically sealed tube, from which the air has been exhausted, the bulb of the thermometer itself being made of black glass. Such an instrument has been in use at the Melbourne Observatory for many years past, and the maximum temperature of solar radiation indicated by it has been assumed and published as the greatest heat in the sun.

In the "Philosophical Magazine" of March 1866, a letter from Professor Tyndall appeared, discussing the results of some observations of solar radiation made by Mr. Glaisher in one of his balloon ascents. The letter concludes by stating that "If these remarks be correct, or so far as they are correct, the indications of the black bulb thermometer, as at present constructed, are delusive, and especially so at great elevations." The remarks he refers to relate to the transparency of ordinary black glass to the invisible, or the greatest heat rays of the spectrum. From this letter we may conclude that Professor Tyndall's opinion stands thus :—

"That the black glass, of which black bulb thermometers are usually constructed, is not opaque to all the heat rays of the spectrum, and therefore these rays may pass through the glass of the bulb to the surface of the mercury, and be there reflected back into space without raising the temperature of the mercury, and that the loss from this cause will increase with the height of the thermometer above the earth's surface.

After reading this I determined to try some experiments in order to ascertain if the maximum heat in the sun's rays was obtained by our black bulb thermometer. I therefore placed another black bulb thermometer alongside, and in all

respects under the same conditions as the one usually registered, but the bulb of the second thermometer was covered with a coating of lamp-black and size, so as to present a dead black surface. These two thermometers read the same in the shade, and as ordinary thermometers were accurately intercomparable. It was immediately apparent, however, that the simple black glass thermometer did not indicate the true solar radiation, the coated bulb always attained a higher temperature than the other, and the difference was found to vary with the temperature—the greater the temperature the greater the difference. It was also observed that the coated bulb thermometer was longer reaching its maximum, and was subject to greater variations, and more rapid fluctuations than the thermometer with the plain black glass bulb.

The following table deduced from observation showed the variation of the differences with the increase of temperature, and prove clearly that the ordinary black glass bulb thermometer is not a reliable means of measuring solar radiation :

Black Glass Bulb.	Coated Glass Bulb.	Correction to be added to Black Glass Bulb.
Deg.	Deg.	Deg.
70	77·3	7·3
75	84·4	9·4
80	91·0	11·0
85	96·6	11·6
90	102·0	12·0
95	107·7	12·7
100	113·5	13·5
105	118·8	13·8
110	124·1	14·1
115	129·3	14·3
120	134·6	14·6
125	140·0	15·0
130	145·2	15·2
135	150·5	15·5
140	155·7	15·7

These results are exactly what we should expect if we accept Professor Tyndall's statement with respect to the diathermancy of black glass. The greatest heat rays belong to the invisible part of the spectrum, just beyond the least refrangible or red end; these rays are known to traverse substances perfectly opaque to all visible rays,* and would therefore pass through the black glass without absorption, be

* Indeed, when every trace of visible rays is sifted out from sunlight, the heat rays collected to a focus can be made to melt platinum—not a trace of light being sensible to the eye until the platinum becomes heated.

reflected back from the surface of the mercury, and lost, while the coating of the blackened bulb being nearly or quite opaque to all rays, the whole heat falling on the bulb becomes rapidly absorbed.

The polished surface exhibited by the black glass bulb too, must reflect many rays which would be absorbed by the dead surface of the blackened bulb, and further, the coated bulb would radiate heat very rapidly as compared with the polished glass surface, and give rise to variations due to the interposition of visible or invisible aqueous vapour in the atmosphere, which the plain glass bulb would be insensible to.

In the numerous observations made with these thermometers, many cases occurred in which the differences already given would not represent the actual observed differences—in some of which there could be no doubt the more rapid radiation of the blackened bulb during the drifting of thin filmy clouds across the sun was the cause of this, and I am inclined to attribute all such differences to the absorption of heat rays by aqueous vapour in the atmosphere, the more sensitive blackened bulb indicating the loss, while the black glass, with its badly radiating surface, remains insensible to such variations. In these fluctuations the lowest temperatures indicated by the coated bulb, were never so low as the highest shown by the plain black glass bulb.

Last December, in a communication I received from Mr. Todd, the director of the Adelaide Observatory, he makes the following remarks :—

"I recently had occasion to substitute a fresh solar thermometer for the one that had been in use for several years. They were both Negretti and Zambra's make, having black glass bulbs, and enclosed in vacuum tubes—the only difference being that the new one had a smaller bulb, and was enclosed in a smaller bulb. They were both compared with Greenwich standards, and had no appreciable error. They also both read exactly alike in the shade, or in hot water up to limits of scales. Yet, in the sun, the old one reads often 10° or 12° higher than the other, according to the intensity of solar radiation. How is this to be accounted for? It is a rather interesting question, because solar radiation observations are no longer comparable if the instruments differ, and I have for a long time noticed, with surprise, that yours and Sydney's observations are much lower than mine, which I have hitherto attributed to our much drier and consequently more heat transparent atmo-

sphere. But here are two first class instruments, of the same maker, made on same principle—reading in shade, &c., alike ; placed side by side, under precisely similar circumstances, differing 10° or 12° in their indications of solar radiation. I have seven or eight of these instruments in store, and I intend to try them all,—I will let you know the result, and in the meantime should be glad to have your opinion as to cause. Is it that the one reading the higher is in a more perfect vacuum, or the black glass different, one less absorbent than the other, or may the smaller outer bulb have anything to do with it ?"

From inquiry, I find Mr. Todd formerly used a thermometer with a blackened bulb, hence the higher solar radiation obtained in Adelaide, and the apparently low temperature in Melbourne and Sydney.

The differences between his new black glass bulb thermometers must, I think, depend on the different diathermancy of the glass of the bulbs, for if black glass is not opaque to heat rays, the thinner the glass the more diathermanous it must be, and it will be interesting to learn if coating these bulbs will render their indications similar or more comparable.

The highest temperatures in the sun published in the meteorological reports of the Melbourne Observatory up till the 1st of January 1868, have all been obtained from the ordinary black glass bulb thermometer, and do not therefore represent the true temperatures of the greatest solar radiation. The table first given furnishes an approximate correction, which, when applied, brings up the temperatures to what they would have been if measured by a blackened bulb thermometer—and I here append the maximum solar radiation for each year since 1860, as observed with the black glass bulb, as well as the true temperatures obtained by applying the correction :—

..	Black Glass Bulb.	Correction.	Coated Bulb.
1860	136·8	15·4	152·2
1861	129	15·1	144·1
1862	144·3	15·7	160
1863	133	15·3	148·3
1864	124	14·8	138·8
1865	126·1	15·1	141·2
1866	130·8	15·3	146·1
1867	131	15·3	146·3
(?) 1868	127·4	15·2	142·6

Art. II.—*Moral Responsibility.* By Mr. H. K. Rusden.

[Read 24th February, 1868.]

Mr. President and Gentlemen of the Royal Society,

I think it will not, and cannot, be contested that the current morality is lamentably imperfect; and that an alarming proportion of society being immoral, it follows that sufficient reasons for being moral are either unknown or do not exist. The fact that some persons are moral affords ground, however, for believing that such reasons are to be found; and if it be possible to discover and disseminate them, so as to augment the number of the moral and diminish that of the immoral, I think that time could not be better spent than in endeavouring to render such a service to humanity. Trusting that this is possible, let us, as an essential preliminary, examine the subject of moral responsibility.

In dealing with moral subjects, great obscurity arises from the arbitrary addition to those qualities of human actions which constitute them physically good or bad, of a totally different and transcendental class of qualities, in conformity with the hypothesis of merit and demerit. The reality of the distinction upon which that hypothesis is based, has been repeatedly and gravely questioned; and therefore it should not be too rashly assumed. A presumption against it is at least suggested by its mysterious nature. But, avoiding the adoption of any premisses which might be disputed, we may safely postulate that the distinction between pleasure and pain, or physical good and physical evil, is more clear, certain, and indisputable, than that which imputes merit or demerit to an intelligent agent. The former is discerned readily and clearly by children and savages, long before they acquire the slightest glimmering of the latter. Many, indeed, never arrive at the conception of merit and demerit; which proves that it is certainly not original and universal, like that of pleasure and pain. Without assuming, as might be contended, that this alone is fatal to the more subtle theory, and desiring to take for granted no more than would be conceded by those who uphold it most strenuously, I propose first to examine the most currently propounded bases for it;

and, if still necessary, to search then for some more definite and consistent principle as a guide to a feasible and universal morality. We surely cannot adopt a course better calculated to attain this end ; and, if we fail to do so, then, I say, that though we may not have proved the popular theories to be merely factitious, still the probability of their reality will be so far lessened ; and, if we arrive at any more substantial and effective principle, then the importance and essential value of the system of merit and demerit,—praise and blame,—will have been sufficiently disproved.

To begin with our terms. The term moral is derived from the Latin (*mos, moris, moralis*), for manners, customs ; and it is often used in a similar sense among us. It remains to be seen whether every practical purpose would not be better served by using it thus only. Moral philosophy is defined as the study of social duties. Moral responsibility implies, beside *moral obligation,*—which I would interpret as the reason why a man acts well rather than ill, because an *obligation,* to be real, should *oblige,*—that he is answerable to some *authority* for doing one or the other. But it seems to me that the day is past when any authority could be quoted as a universal guide for conduct. The idea is wholly repugnant to the tendencies of modern thought, which entirely claims, if it cannot secure, for man, exemption from control by any power in the constitution of which he has no voice. Even under the most despotic monarchies of Europe, the principle of no taxation, and even no legislation, without representation, is asserted by all who dare to speak their minds.

But to whom or to what, and in what manner can man be responsible or answerable for his acts ? Some will say to God. But the existence of immorality proves that God does not interpose to prevent it, which is the very thing that we require ; and all who recognise and appreciate the absolutely sequential operation of natural forces upon man, as inevitably as upon any other object in the universe, and the proof of this afforded by statistics ; must see, that, as physical and social influences are all that are certainly discernible as affecting or necessary to account for the conduct of man, and are fully adequate causes of all such effects, the gratuitous introduction of doubtful occult forces can be productive only of complication and difficulty. In any case, upon thousands who admit a divine authority it is notoriously practically inoperative ; and it is necessarily so upon all who know

nothing of, or disown it. It has thus to give way to the agent whom it should govern, and the man proves superior to his authority. And as thus no authority, even though divine, is adequately operative upon those for whose control it is most required, the principle, as affecting morality, must be dismissed as inefficacious and invalid; for what we want, and what is indispensable, is a principle of universal, not of partial application or force.

But the moral efficacy upon conduct of the theory of a future state of rewards and punishments forms another essential part of the *religious sanction*, as it has been called; and has been so commonly deemed indispensable as a basis of moral government, that it demands careful consideration, notwithstanding that it involves that of the authority of a Deity—which, as regards the prevention of immorality, we have already been obliged to relinquish. Let us therefore here, for the sake of argument, admit the authority of a Deity as the only one competent to effect a *post mortem* rectification of mundane conditions, and examine whether this doctrine, which includes the whole relevant part of the religious sanction, combines the indispensable conditions of consistency with itself and universal efficacy upon men.

When we consider that any theory which demands a state of future existence, as necessary to provide an opportunity of satisfying or completing justice in the administration of this life, actually and essentially involves the rash, not to say impious assumption of injustice in the Divine government *here;* and also, in addition, of a radical change to an entirely opposite treatment *hereafter;* we cannot but acknowledge that a theory of morality which should require such a basis, would be subversive not only of itself, but also of a belief in two of the most important attributes of the Deity—justice and unchangeableness.

To hold *that God does or permits evil that good may come,* seems to me the very essence of blasphemy; for to assert that he *cannot* effect all good without any evil, amounts to a denial of his omniscience or omnipotence; and to say that he *will not,* is even worse; being a positive imputation of malevolence. And if in man such conduct can only be excused by stupid ignorance, its culpability should augment in proportion to knowledge. Inconsistency thus seems inherent in the theory.

Still, to secure a universal basis for moral principles is an object of so much importance, that *certain efficacy* might

atone even for such inconsistency as I have just exposed, and would lead me to suspect an error in the argument; which, however, would be proportionately strengthened should the contrary appear. I will therefore consider the *effects* of the theory of a future life upon present morality.

It seems proper to remember that all the evidence for the probability of this theory, is purely traditional, and derived from a comparatively barbarous ignorant age; and we know that opinions, even among its advocates, have always been divided as to its possible reality and conditions.

It seems clear that any theory at variance with experience, and of which all verification and tangible proof is so indefinitely postponed, can at best have no more than a doubtful influence even upon the speculative and curious, and cannot be supposed to govern the impulsive busy mass. The motives to conduct afforded by any such considerations must necessarily be weak in exact proportion to their distance and uncertainty, as compared with present, pressing, felt wants. We all know that force acts inversely as the square of the distance. So the distance or frequency of the sittings of courts of justice, determines in miles or in hours the amount of their moral effect. Altogether the whole subject of *post mortem* conditions is necessarily so obscure, that as regards motives to conduct, it can furnish none to compete in vividness and strength with present, potent temptations, and immediate urgent necessities, which obliterate all distant and merely supposititious considerations. Whenever the two classes of motives compete, those which are least distant and most certain, are inevitably victorious. If we find that facts corroborate this opinion, the inefficacy upon conduct of the theory of a future life will be substantially established, and my argument of the inconsistency of the doctrine practically confirmed.

It is surely incontestable that there is a proportion, and probably everywhere about the same, of men of every religion and in every country, who are really good, and another of those who are bad; the one class comprising those whose conduct forms the criterion of the local moral code; and the other, those who fall below and violate it. The precise relative proportions of the two classes are immaterial to my argument, but their existence is indubitable. A part, and a part only, of those who are good, inevitably profess the local religion whatever it be; for those well inclined, unless unusually critical, eagerly adopt the reasons cur-

rently taught for acting well, and naturally accept them as valid and true. But though the conduct of a few may give some plausibility to the notion that their theoretical principles cause their pure practice, the indisputable facts—that religions are as antagonistic as they are various; that men are good or bad, though of any or no religion; that large numbers are, equally with the best, exposed to religious influences without becoming moral; and that the most pious men have been betrayed into vindictive and cruel intolerance by their religious principles and feelings,—prove that virtue is caused not by religion, but rather by individual intelligence and temperament, developed by cultivation and modified by those natural conditions of climate, diet, and scenery, or what Mr. Buckle calls "aspects of nature," which determine the general characteristics of nations and their local moral customs. These, again, are of course affected by changes in their social relations and their advances towards civilization. And it seems to me a grievous libel upon those whom we instinctively revere and love for their inherent virtues (as well as an outrage upon common sense) to say that they are by nature and inclination abominably sinful; and that their good qualities are not really theirs, but are wholly attributable either to a theoretical system current where they happened to be born, or to the overruling influence of a capricious Deity, impiously asserted to soften or harden whom he will.

Moral rules have sometimes been advantageously formulated by teachers of religion, who were compelled to adopt and incorporate them with their dogmas, to which they could otherwise never have hoped to secure a listener. For no theory of immorality would be tolerated among men. Every religionist devoutly fancies that it is his religion which makes him good, and is surprised that others can be good on any other principles; indeed, he is often inclined to deny the fact, and to regard their virtue as mainly spurious; whereas, in truth, his own virtue is owing to his superior organisation and to the natural morality with which he has associated his religion, and which alone renders it acceptable. As a proof of this we find that whenever the religion has been pushed into predominance, morality has been to the same extent sacrificed; real moral ties have been subordinated to supposed supernatural duty, and violated to such an extent as to produce among rude nations, even the immolation, not only of enemies by their conquerors, but of children by their

parents; and in partially civilised times and countries, the results have been those fearful reciprocal persecutions and wholesale massacres which constituted far more pernicious evils than any pestilence or famine; inasmuch as in addition to the cruel destruction of innocent thousands by deaths often devised as the most painful, the bitterest hatred and rancour were excited and aggravated to an extreme to which no other known cause has ever proved adequate. Such effects can only be considered as distinctly antagonistic to all genuine morality. The radical difference and even opposition thus shown to exist between the religious and moral sanctions, teaches us that their aims and functions should be entirely dissociated; that their connection is illegitimate, and their offspring therefore an abortion or a monstrosity.

It may still be said, however, that man is responsible to society; and this might hold while his acts affect society, and he not only acknowledges but bows to its authority. But society takes no cognizance of many of his acts, and very imperfectly prevents what it knows and disapproves. And who can deny his right to throw off its authority when he has the power? It is because he actually *does* this whenever he lists, failing to perceive that his highest interests are best served by yielding to the restrictions which society imposes on each for the benefit of all, that we are driven to seek a more universal and effective basis for morality. The fact that any mere authority *can* be contravened with impunity, is fatal to the efficacy and validity of the principle in any shape or form.

To what then can man be responsible? and in what consists his obligation to virtuous conduct? Let us analyse his position and the facts. When man is tempted to commit a social offence, or any act whatever, and regards solely his object or himself, he experiences no check but what is imposed by direct physical obstacles; which however are often wanting, and the act is forthwith completed. If, however, he abstain, it is in every case either from mere habit, which avails nothing in unusual circumstances, or from *a consideration of the probable direct or indirect consequences of the act.** This I think must be evident.

* "First I conceive that when it cometh into a man's mind to do or not to do some certain action, if he have no time to *deliberate*, the doing it or abstaining *necessarily* follows the *present* thought of the *good* or *evil* consequence to himself."—Hobbes's Works, vol. iv., p. 272.

Animals act without reasoning—man can reason, and thus is in a position to become a moral being; but he cannot be perfectly moral unless he not only reasons, but reasons accurately, and also acts accordingly. If the consequences would apparently be evil to himself, so much more evil than the immediate or prospective good as to compensate for any difference of distance—if the general balance of probable results be evil, or *appear evil to him*—he will, nay, he must, forego the lesser for the sake of the greater good, and avoid the preponderant evil.

If it be said that some men act for the good of others to their own manifest injury, I reply that they do so solely because it pleases them best. Their own pleasure is far greater in contemplating the distribution of good among others, than in the limited inferior pleasure of sense. They *feel* that it is more blessed to give than to receive. The indirect or moral intellectual pleasure is superior *for them* in degree and in kind, in extent and in duration, to any direct and merely sensuous one; but both are physical results of reflex nervous action, and unless a mind is nearly as narrow as a beast's, it cannot be satisfied with mere direct temporary enjoyment. An organism with a brain bearing a large proportion to the rest of its nervous system, cannot be satisfied with gratifications which arise or locate in the subordinate parts of that system. Where the convolutions of the brain are large and numerous, they imperatively demand, and in a healthy system, reproduce the activity which first developed them; and it is only in nervous systems, whose function is fitted for little more than to support life, that what may be called organic pleasures can adequately satisfy their demands.

Doubtless much, and very much, depends upon the accuracy of man's apprehension of the probable good and evil consequences of his acts. If this be so, then to the precise extent to which a man is alive to, and justly appreciates the consequences of his actions, he should invariably choose the greater good or lesser evil; which accordingly we find to be the case around us.

As the value of this principle rests upon the inseparability of any act from its consequences (which is now an acknowledged scientific fact as regards all events whatever), it follows that the indispensable condition of universality of application is perfectly fulfilled. The other condition necessary to its complete efficiency—knowledge, and sagacity in

the apprehension of consequences—experience unfortunately proves to be too often unfulfilled; were it otherwise we should not have to search for a rule of conduct. But the fact that men with knowledge and sagacity most seldom err, while those without such qualities constantly do so, is a strong argument for the validity of my principle; while the rapid and wide extension of knowledge, and the daily-increasing appreciation of it, afford solid ground for hope that it will eventually be universally recognised. That the necessary consequences of every act are morally or indirectly appropriate, requires to be known and thoroughly understood; indeed, in comparison with the due apprehension of this fact all other knowledge is futile and worthless.

For the whole of his conduct man thus is evidently not responsible to any authority, but strictly amenable to physical consequences; and the degree of his comprehension of them is the measure of his obligation. Responsibility is a phrase scarcely appropriate in such a connection, although sufficiently intelligible. Responsibility then, or amenability to natural consequences, is co-extensive with the power of action, and ignorance of them does not exempt from infallible retribution. Obligation is measurable by the extent of apprehension of those consequences; and social penalties partially remedy ignorance of them by adding more perceptible unmistakable penalties to those natural ones which are generally overlooked. With society, ignorance of social penalties is seldom, though too often, admitted as a ground of exemption; but with inexorable nature ignorance is never admitted as an excuse. Society, however, thus indirectly remedies ignorance of *natural* consequences, by teaching offenders the knowledge of them, which they evidently want. Man is exactly recompensed by natural consequences, for observing or violating the laws which experience dictates as necessary to preserve his life, health, and general well-being; and liable to social consequences for observing or violating those prescribed by the society in which he lives. This social responsibility is only rendered necessary by the deficiency of his comprehension of physical consequences, by his general ignorance of natural effects; and thus partially makes up the difference between his obligation and his responsibility. In nature he is irresistibly impelled to maintain his existence and health if possible; he is provided more or less adequately with means; and he is with perfect measure rewarded for wise attention, or punished for disregard, to

natural laws by the natural consequences of his acts, and *by them alone.* There is no fact better established than that attention to, or neglect of, diet, temperance, or hygiene, is followed by peculiarly appropriate consequences; as also that in cases of constitutional defect, where wise conduct is unavailing to secure the usual reward, so many are traceable to the ignorance or carelessness of ancestors, as to justify the conclusion that the principle holds good with the race when it seems to fail with the individual; and though on any principle of merit and demerit this could not be excused or justified by any expedient, there is really nothing whatever which detracts from the perfection of the course of nature. Where the error has been carried to an extreme, death ensues, sometimes without the extension of the evil to posterity. When it is possible that in posterity the ill effects might be counteracted by greater knowledge, the opportunity is afforded; but when persistently neglected, injury to the race is prevented by the extinction more or less rapid of the family, which should form a salutary warning to other individuals of the race. And such examples would always produce their visible good results were such effects readily traceable to their causes. But that they are not is the most powerful stimulus to their study; and when physiology is properly and generally understood, a key will be held, fitted to the solution and remedy of most of such difficulties. But this want of knowledge is also in fulfilment of another law as vast and significant as any, and of immense importance in every science. Without the urgent want there could be no vigorous action. There is no motion, physical or moral, but under the necessitation of the aggregate of its antecedents; and from man's most stringent needs always arise his most effective energies. The more a spring is bent the stronger is its rebound. The politico-economical law of demand and supply pervades all sciences, and forms only one of the innumerable bonds which knit them together into one harmonious whole.

I have dwelt upon hereditary evil for an illustration, as being one of the most complex but pregnant problems of all, and therefore the better test of a principle; and I only wish that I had time to do it justice. Viewed socially, the same apparently anomalous facts furnish society with a reason, which it could not otherwise learn, for discouraging in individuals, acts which would ultimately tend to injure the race.

But simpler instances are far more obvious and common. For the same principle extends as far as the meaning of the word moral—to all man's manners, customs, and acts. Fire is destructive of his bodily tissues. The first experiment convinces him of it, and if he be wise he will not even try a second. If he fight with his neighbours, he is hurt; and suffers, though he conquer. Peace therefore is moral, and war is immoral; but as man, when ignorant, acts from impulse and habit and not from principle, war is still only too frequent. If he break the laws of his nation, society avenges itself upon him for the offence; but I wish to draw a distinction here between the offence against society—which it seems to me consists in the breach of its laws—and the offence against the natural rights of any individual, both being included in the same act. It strikes me that man's responsibility, or certain amenability, to natural consequences, should be distinguished from his responsibility or liability to social consequences, though the act be one and the same. The natural consequences of any act are in themselves amply retributive, which in many cases is not recognised; the fact being lost sight of behind the more plainly perceptible penalties inflicted by society for the infringement of its laws alone. Take the case of a liar. Society punishes merely false oaths, which impair its judicial administration. The general contempt, avoidance, and other detrimental results of having the reputation of a liar, are *natural*, not *social* consequences; for they spring from the spontaneous, self-defensive action of individuals, not from the organised action of the social body. But natural evil consequences are inevitable for the slightest infraction of truth, and are eventually far more severe, indeed all the greater in proportion to its apparent success; to the extent to which the lie is believed. For when a man utters a falsehood, and is thus led to regard it as advantageous to him, he doubly misrepresents and inverts facts to himself, and acquires a fatal misconception as to the relative value of truth and falsehood; his judgment becomes distorted; every repetition of the offence against himself and nature increases the perversion of facts; he soon loses all power of representing things correctly to himself, or of judging accurately of the probable effects of his words or acts; unless extraordinary circumstances forcibly impress upon him the true cause of his insidious error, his mental degeneration becomes complete; and whatever may have been his original intellectual capacity, he is nearly sure to

become inextricably lost in a maze of difficulty and ruin. But in any case the mental deterioration forms the severest retribution, and none the less, but rather the more so, that it is so insensible. Nothing is more ordinary than for persons of even superior abilities, if they once engage in a course of falsehood and deception, entirely as it were to lose their head, and to commit themselves at last in a manner absolutely childish and unworthy of their natural capacity, and utterly inexplicable in any other manner with which I am acquainted. If I name as an instance, Dixon, of the Oriental Bank, the example may have more force than my argument. That Dixon acquired his position in that institution is proof that he at first earned and deserved confidence; and his capacity for judging wisely and rightly must have been vastly superior at the beginning, than at the end of his career, when he not only was guilty of the most puerile and profitless duplicity, but appeared also altogether incapable of perceiving either his dishonesty or his folly. But even when falsehoods are told with what are deemed the best intentions, it is almost always perceptibly the case that beside the unconscious but inevitable mental injury, the purposed object also is defeated, and it becomes apparent after all that truth would have answered best. And it is clear that even cleverness and sagacity cannot avail to enable a man to discern when a lie would be advantageous to him; for he views things from a deceptive stand-point, and it would be wonderful indeed if even the severest logic were to deduce from erroneous premisses anything but false conclusions.

We can all bear witness to the appropriate ways in which various vices *produce* their own proper and significant penalties. Intemperance, debauchery, lying, idleness, dishonesty, selfishness, ignorance, all not only meet with, but clearly *cause* more exactly appropriate punishments than any with which society visits those offences of which it takes cognizance. I think that the fact that such habits are indirectly though surely recompensed by their own necessary consequences, constitutes them moral offences, and that it is only when they are publicly injurious to others, that they become offences against, and are punishable by society. But whether such bad habits culminate or not in open social offences, they infallibly bring their own natural retribution of physical and mental deterioration; and the ever-increasing but unfelt difficulty of recovering from or staying that deterioration, is its most dangerous and fatal feature. The degrading results

of confirmed drunkenness or gambling need only to be mentioned. How frequently do we see degraded ruffians, who for years have never felt a higher sentiment than brutal selfishness, at last committing openly, even such acts as murder, although directly contrary to their false views of that self-interest which is their professed rule of conduct. And when it then becomes the interest and therefore the duty of society to remove or destroy a criminal, it must also be the criminal's best interest to be so disposed of. His degeneration, though unconscious, accelerates so rapidly and becomes so irremediable, that every step only plunges him deeper and deeper into vice and into misery.

How delightful to remember that equally appropriate rewards are the inevitable results of temperance, probity, industry, benevolence, and knowledge! How true it is that honesty is the best policy, and that virtue is really its own reward! How true it is that these rewards are strictly though indirectly physical, arising from reflex social action, and are therefore called moral!

Some persons profess to be shocked at the idea of recommending men to he honest or moral from motives of policy; of making virtue a question of mere self-interest. I should not demur to this high-flown æsthetic sentiment being adopted as a rule of conduct by those who recognise its force, provided it were found effective. But notoriously, it is not only inoperative upon, but beyond the conception of all but a very few; indeed those who uphold it are not always as observant of it as their professedly selfish neighbours. But what we want is, a principle of universal application; one which has, if possible, more weight with those of evil tendencies and habits than with those of good. Any other is absolutely worthless; for it is the immoral, and not the moral, who require a motive, and an incentive to alter their conduct. I am convinced, however, that it is only in speculative argument that the idea is entertained at all; that it never affected the conduct of anyone when more powerful reasons did not support it,—sufficient to outweigh entirely all temptation to the contrary;—but men like to hug themselves upon the *nobleness*, rather than the truth of the motives they can find for their own actions, and to assume a virtue though they have it not.

It may be said that it is not proved that fully adequate rewards and punishments are natural inevitable consequences of all human acts. Granted; it is not proved.

Neither is it proved that the action of gravity is universal. Still the practical universality of the force of gravity is so certain as to be accepted as a safe assumption ; nay, a valid principle ; and a historical comparison of the two cases will show no material difference in the probable reliability in each. The validity of the principle that every event is the necessary result of its antecedents, physical and moral, and must also cause as necessarily its consequences (which must also be its appropriate moral consequences), is substantially enunciated in such notorious maxims as "Everything must have a cause ;" "Honesty is the best policy," &c. This principle is the basis of all experience and knowledge, and its truth is proved by their mere existence. Curiously enough, it is only beginning to be appreciated, Mr. Buckle being, I think, its first consistent expounder. It was practically admitted in conduct (the only true test of opinion) long before it was distinctly affirmed, but it has always been theoretically contested on the ground of apparent exceptions. But gravity was known as a principle long before Newton showed that it was apparently of universal application. The supposed exceptions exhibited in the perturbations of the planets were subsequently recognised, but did not make wise men despair of the principle. They had confidence in it, and worked it out, until they demonstrated that the apparent exceptions were really exemplifications and proofs of the immutable law.

I will now attempt to view historically the origin and progress of both the genuine and the fictitious ideas of moral responsibility and obligation.

In a primitive state of existence, man's wants are so few that it is generally long before he arrives at the conception of the exclusive right to property. But it naturally arises when what he acquires costs him labour, and as he becomes civilised, and his wants and possessions increase, so does the notion of the right to property acquire strength with exercise.* But it is long before he learns to add to it what it

* Since writing the text I have been fortunate enough to meet with strong corroboration of my theory, in a work by an author classed by Buckle, as, "by far the ablest traveller who has published observations on European "Society." Hist. of Civil. vol. i. p. 239. "In this nation of small pro- "prietors the sense of honour is more developed, and more generally diffused, "than in the countries feudally constituted. Loss of honour has been from "the earliest times, a specific effective punishment in the criminal law of "Norway, standing next in degree to loss of life. The possession of

evidently had not at first; the idea of demerit in anyone who deprives him of what he claims, who infringes on his right to the proceeds of his labour. As this idea is unknown among savages and young children, or any but an organised society, and commences about the period when society first becomes established by mutual agreement upon rules of association, or at the age of comprehension of the advantages of co-operation and reciprocal security, it seems probable at least, that these two circumstances have some causal connection. The ideas of merit and demerit appear to me to have arisen from the reciprocal demand for and supply of sympathy and support by social allies, to resist aggression and co-operate in labour; superadded to the simple sympathy and antipathy of an earlier development, and exaggerated by the unfortunate predominance of feeling over reason. There is no antipathy in the feeling with which an animal is pursued for the purposes of food; but it is strong in the chase of dangerous beasts of prey, and is proportioned to their power to harm. Still this is but antipathy, and there is nothing more in the wars of savages and the squabbles of young children, who cannot be said to have attained to a social condition. Even civilised people who readily recognise and deprecate breaches of moral right, *inter se*, exterminate savages and appropriate their possessions, without considering the principle infringed, or feeling more than simple antipathy at most. They *first attribute blame* to such savages, for *conscious breaches of their moral code*, as they do to children when they likewise become familiarized with, and appear to comprehend their conventional notions of social rights and duties. On the other hand, praise is awarded by them for the readiness with which some children and savages comprehend and conform to such notions of moral right and mutual service, and thence also the corresponding idea of moral responsibility and obligation.

But it is after men have begun to experience the security and the power afforded by occasional and prolonged reciprocal assistance and co-operation in labour and defence; and when they begin to agree upon rules and conditions upon

"property naturally diffuses through all classes the self-respect, regard "for character and public opinion, circumspection of conduct, and considera- "tion for others, which flow from or are connected with the possession of "property, and render these influential on the morals, manners, and mode "of thinking of the whole body of the people." S. Laing's "Residence in "Norway, 1834-6." Part I., p. 152. Traveller's Library, Longmans, 1851.

which such benefits shall be mutually given and received; that their sympathy and antipathy extend beyond themselves and those things in which the investment of their own labour has created a personal interest; and they come to regard aggression or depredation committed against their social body, or against any individual, or right, or law, or custom of it, as an indirect or moral injury to themselves. An individual, in calling upon his neighbours to resist or prevent an aggression upon himself or any of them, from within or from without their social body, naturally represents the offender as a proper object of antipathy and hate, and claims protection and united action against him, from their sympathy and sense of mutual interest.

Here then, I believe, was the origin of the idea of *indirect*, or *moral obligation*; and the first germ in connection with it of that sentiment which subsequently developed into the system of praise and blame, merit and demerit, which I propose to trace a little further. The idea of moral *responsibility*, I think, belongs to, and must have originated in, a different and ruder form of civil society—that of the paternal government, chieftainship, or monarchy; which is the development of the principle of authority, and perfectly adapted to the government of children. The mutual dependence and reliance generated by the operation of the democratic principle, experience teaches us are far more appropriate and favourable to the equal conditions, the capacities, the activity, and the prosperity of adults, national as well as individual.

That this view is correct—that the notion of merit and demerit, desert for praise and blame—is compounded of, first, the feeling of the right to property, acquired from the consciousness of having expended labour for it; secondly, the sense of mutual advantage and reciprocal dependence, ensuing from combination, first casual and temporary, afterwards permanent, and resulting at last in social security and collective power; thirdly the sympathy and antipathy which, by the force of habit, men readily learn to transfer beyond the immediate to the most indirect perceptible causes of pleasure and pain; and lastly, the gradual exaltation of the whole into a transcendental region of sentiment in proportion to the development of what is called the æsthetic faculty. This account of the concrete idea is strikingly corroborated by the fact that in the history of the world, the developement of the moral sentiment originated almost

entirely among democracies or republics, where the sense of mutual dependence, confidence, and security, was the leading principle of action and thought; and was far more slowly and imperfectly introduced into despotic monarchies, where that of dependence upon authority took its place. The moral effect of social co-operative unity was strikingly exemplified in the republics of Greece and Rome, where it may be said to have attained a morbid growth; for so intensified by the æsthetic element was their moral sentiment of patriotism and individual virtue, that in deference to it they not only freely sacrificed their private interests and their lives, but they frequently, on principle, involved their own adored countries, as well as those of their adversaries, in the miseries of war and devastation. Contrast with their conduct the debased condition of the eastern monarchies, where, though civilization had an earlier beginning, the moral development, not only then but almost ever since, has notoriously exhibited altogether inferior results.

I have characterised the exalted and generally admired patriotic sentiment of the Greeks and Romans as morbid, because the evil results proved it to be, in such an extreme, pernicious; though doubtless it was necessary as a link in the chain of events, and for the enlightenment of the human mind to the advantages of mutual confidence and combination. Of the two, the Roman sentiment was the most practical and least æsthetic; and the stern vigour of their morality, of which Regulus afforded a significant example, had throughout Europe a powerful effect, which long outlived their political fabric. To its enervation, first by the influence of the more æsthetic Greek development, and to its subsequent rapid degeneration under the principle of authority which supervened with the emperors, do I attribute its complete suppression, until the revival of trade and commerce, and the consequent reappearance of the republican spirit after the long night of the dark ages. For nearly a thousand years did that enthusiasm, which lost its direction and object on the severance of the old republican bonds of mutual interest and united power, unfortunately find nothing with which to ally itself, but the religious sentiment; and thus formed with it the most appalling scourge with which human nature has ever been afflicted—fanaticism. Engrossed exclusively by imaginary visions of supernatural duties, and therefore bereft of data by which to check and regulate their exaggerated exaltation, all scientific

knowledge and habits having entirely disappeared before pious asceticism and intolerance, men seem to have found the chief vent for their sympathies and antipathies in injuring and torturing not only others but themselves. In the previous democratic period, when dialectics and culture rapidly developed the minds of men, they not only acquired an enthusiastic activity, but first learned to subordinate their own interest and happiness to those of others. Still this development was morbid and exaggerated ; for the general interest of the human race is as much injured by a narrow, greedy patriotism, which seeks its own aggrandizement at the expense of other nations, as the real interest of the individual is damaged by the notion that it can be really served by depredations upon others. But the subsequent age of religious frenzy was infinitely worse. Men were wholly possessed by an insane superstition, in which they preserved no features of their former progress but that energy and self-subordination which then misdirected them into the wildest excesses ; and there appear to have been few of any intellectual activity, whose pious rage could be satisfied with less than either enduring the pangs of martyrdom themselves, or of inflicting them on others, for the glory of God. At last, fortunately, the paroxysm spent itself. Population had gradually multiplied so much that in many places men were driven by their increasing wants to agriculture and to trade. These necessarily restored the sense of mutual dependence, confidence, and reliance. The republican spirit revived. The Reformation then for ever burst the bonds of authority, to which the human mind can never again be submitted ; for the invention of printing has secured the permanent advance and wider dissemination of knowledge for the future. The sympathies and antipathies of men are now being gradually brought under the government of reason, after the chastening of a salutary though dreadful experience ; while the superiority of the ratio of the increase of population, to that of the means of subsistence, secures the maintenance of an abundant and sustained energy. We have, at last, arrived at an age of unfettered criticism ; at a day of judgment. But fearful evidence of the severity of the ordeal through which the human intellect has passed is still everywhere perceptible, and it still exhibits symptoms of the panic by which it was lately transported. The fancied belief in a *super*-natural *in nature*,—in a transcendental moral faculty, in a theory of more than moral

duty,—and above all, in a hypothetical future; still too much distracts the attention of men from their present practical physical requirements, leads them to depreciate and neglect their advantages; and opposes, though with daily decreasing power, the irresistible progress of that scientific knowledge, in which alone the prosperity, happiness, and true virtue of the human race, are to be sought and found.

But throughout this hasty sketch of the genesis of the idea of moral responsibility and obligation, there is nothing to indicate the existence, or to demand the importation of any more mysterious principle than physical advantage and conventional convenience; the cause and explanation of current theories being, that in the matured social system, the causes of mental phenomena are much more complex, indirect, and therefore obscure; and at the same time the inchoate sentiment becomes more refined and defined, than in a very primitive condition of society. This seems to have led men insensibly to regard all indirect consequences of an act, as if inhering in the act itself; and it is called moral or immoral, when its *general tendency* only can be discerned as it were by habit; its physical consequences becoming too complicated and numerous to be easily traced. A moral man is of course one who customarily does moral acts, or such as are calculated to produce generally good effects; an immoral man is one who habitually commits acts of an evil tendency, according to the moral standard of the society in which each lives. It is corroborative of this view, that morality is as variable as the conditions of climate and of civilisation. Hospitality is incomplete in Lapland and elsewhere, without the concession of conjugal privileges in favour of a guest. In Ladak, &c., it is moral for a woman to have several brothers for her husbands in one house; and in Fiji and Melanesia, it is a moral duty to bury parents alive. All these customs are practised under a moral obligation. Among our own ancestors within three centuries, it was meritorious to burn one's neighbour alive if of a different religious opinion. A pious bishop thanked God that he had been enabled to burn alive after torturing seven hundred in a single year, and he died in the odour of sanctity. None of us, probably, would envy him his state of mind; still it must not be overlooked that that would be one of virtuous self-complacency, and the reverse of that of any man who should do so in our times. When *his* piety was most fervent, his acts were what *we* deem most

atrocious. But as beyond dispute he acted conscientiously, we cannot blame him; his knowledge being the measure of his obligation. And his case is only one among thousands. Calvin in the same manner, in a religious paroxysm, burnt Servetus alive on a fire of green faggots, and was thus most criminal when most pious. But the only difference between them and us is, that we have acquired more knowledge of physical science, and consequently of the nature and social relations of man; while their rule of conduct was simply their religious duty, as deduced from the Bible. If it be said that they mis-interpreted it, that is only one proof among thousands, that interpretations of any such standard are and must be as various as men; and a demonstration of the inefficacy of any mysterious and therefore supposititious principle.

Altogether it seems clear that such notions as desert for praise and blame, and merit and demerit, are the results of the force of imagination and idealistic habits, upon a groundwork of ancient conventional customs; and that they are purely arbitrary and factitious. For all proves that standards of morality vary with degrees of latitude and the lapse of time; and that he who conforms to, or violates, or endeavours to improve the local current standard, whatever it may be, must as necessarily experience the exactly proportioned and appropriate consequences, as the planets must fulfil their cycles in accordance with the law of gravity.

I have now endeavoured to establish consistent and practical moral principles upon patent facts, and the invariable relation between causes and effects which it is impossible to infringe, instead of upon a mysterious fiction, which is directly violated daily by whosoever lists; to prove that it is only a superficial and erroneous observation which leads to the supposition of any injustice in the mundane distribution of pains and pleasures;—a fundamental error, which, while it forms the motive for imagining endless methods of compensation, can never explain or remove, or more than evade the anomaly, that the injustice so assumed must be the deliberate act of the Deity; and I trust that I have succeeded in showing that we are justified in attributing absolute infallibility to the rule that every effect of every cause must be the most perfectly appropriate, morally as well as physically; and also that careful examination will transform even apparently vitiating exceptions into irrefragable proofs of its validity.

I have contended that one condition only is still wanting to man, to enable him to perfect his morality; and that is, full knowledge of the natural consequences and of the causes of his acts. I have pointed out also that his morality is always proportioned to such knowledge. The obvious lesson, therefore, which I deduce from the whole is that, to extend and disseminate knowledge (and most of all among the ignorant and vicious) as widely and completely as lies in our utmost means and power, is not only our best policy and highest virtue, but our most sacred and imperative duty.

These principles may be formulated thus :—

1st.—That every event, physical or moral, is the necessary result of its antecedents.*

2nd.—That moral power is simply indirect physical force.

3rd.—That the highest interest of the individual and that of society, cannot really conflict, but are absolutely identical in every instance.

4th.—That man's knowledge is the measure of his obligation to virtue, and of his prospect of reward; while his responsibility or certain amenability to the necessary and appropriate consequences of his acts, is coextensive with his power of action; and

5th.—That virtue is therefore really its own sole and ample reward.

---

* Hobbes has I think conclusively shown that *any sufficient* cause, *must* be also a *necessary* cause. "I hold that to be a *sufficient cause*, to which "nothing is wanting that is needful to the producing of the *effect*. The "same is also a *necessary* cause. For if it be possible that a *sufficient* cause "shall not bring forth the *effect*, then there wanteth somewhat which was "needful to the producing of it, and so the *cause* was not *sufficient*; but if "it be impossible that a *sufficient* cause should not produce the *effect*, then "is a *sufficient* cause a *necessary* cause, for that is said to produce an effect "*necessarily* that cannot but produce it. Hence it is manifest, that what-"soever is produced, is produced *necessarily;* for whatsoever is produced "hath had a sufficient cause to produce it, or else it had not been; and "therefore also *voluntary* actions are necessitated.

"Lastly, that ordinary *definition* of a *free agent*, namely, *that a* free agent "*is that, which, when all things are present which are needful to produce* "*the effect, can nevertheless not produce it*, implies a contradiction, and is "nonsense; being as much as to say, the cause may be *sufficient*, that "is to say, *necessary*, and yet the *effect* shall not follow." Hobbes's Works, vol. iv., pp. 274, 275. I cannot but consider that the succinct wisdom of these weighty words is unsurpassed, and their scope must be startling to whoever will ponder them as they deserve.

ART. III.—*On a Pair of Scissors for the excision of Snake-bite.* By GEORGE B. HALFORD, M.D.

[Read 9th March, 1868.]

Professor Halford exhibited and explained a pair of scissors which had been made under his direction, for the excision of snake-bite, by which the piece of flesh might be cut out immediately after the bite was received. He remarked that all the remedies which he had tried for snake-bite had failed, and as he had read of one or two painful deaths from snake poison in the papers, he thought it became their duty to consider whether they could not provide an instrument which would enable people immediately to cut out the piece, and throw away the poison. The instrument which he submitted could easily hang by the side, and might be carried about by sportsmen, squatters, and others likely to be among snakes. The great recommendation of the instrument was that a man could use it himself. The two blades of the scissors were curved, and they had a point or spike which, when the scissors open, would be driven into the bitten part. As they shut, the scissors pressed this point, which rose, bringing the flesh and skin with it. The blades of the scissors then severed the piece of flesh, and it was thrown away.

ART. IV.—*On the Application of the Cold, resulting from the Expansion of Compressed Air, to the Preservation of Animal Food.* By Mr. J. DAVY POSTLE, C.E.

[Read by Mr. R. L. J. ELLERY, 20th April, 1868.]

It is generally admitted that in freezing animal food we employ one of the most powerful antiseptic agents known; but though little diversity of opinion can exist upon this point, it is frequently contended that the expenses and the uncertainty, attending the reduction in temperature of a large body of meat on board ship, would preclude the idea of any commercial advantage being derived from an enterprise based upon this process. I shall endeavour in this paper to show that it is possible, by mechanical means, to reduce and to maintain at a temperature considerably below

the freezing point the atmosphere of a room or of a ship's hold, and this at an expense not very much more than would be entailed by communicating a quantity of heat to the air reduced in temperature, equal to that which had been abstracted by the means alluded to above.

That a change in volume is always accompanied by a change in capacity, for heat is the law I employ to effect this change in the temperature of air. Theoretically, in selecting any gas as a medium to utilise this law, I should choose one possessing a high specific heat, as on compression from equal volumes to equal volumes, the latent heat rendered sensible in any one gas, is to the latent heat rendered sensible in any other, as the specific heat of the one is to the specific heat of the other. But for practical purposes, when the object to be attained is that stated above, I employ the atmosphere, it having the advantage of being always obtainable, and of not possessing any injurious qualities, as almost every other gas does in a greater or a less degree.

The conduct of air in expanding is marked by a certain peculiarity that, at first, appears somewhat perplexing, yet, on investigation, this seeming inharmonious department is discovered to be in consonance with one of nature's grandest laws—the indestructibility of force. I refer to the fact that air, on expanding from a certain volume in an elastic medium, does not apparently evince a capacity for heat equal in quantity to the heat developed by its compression to that volume from a volume equal to that to which it expands. You will observe that I use the word apparently, for, in accordance with the law previously mentioned, its capacity is exactly equal. To explain this result, it must be remembered that the atoms of air in expanding acquire momenta, which represent quantities of heat; when these momenta are destroyed, the heat which they represent is rendered apparent, and assists in diminishing the fall of temperature due to the sensible heat of the air being converted into latent heat by its expansion. This is a phenomenon of the utmost importance, and should be prominently kept in view in all attempts to obtain cold by the expansion of gases. Several comparatively unsuccessful attempts (including the inventions of two distinguished philosophers) to produce cold by the expansion of highly compressed air, are due to a misapprehension on this point. Sir John Herschell says that "An old steam-boiler buried some twenty or thirty feet

under ground, in well-rammed earth, and furnished with a condensing-pump (worked above ground), and one eduction-pipe, opening by a stop-cock through a hose into water, would in all probability supply an *ad libitum* quantity of ice for the use of a family in the country, the condensation being performed over night."

Professor Piazzi Smith, Astronomer Royal for Scotland, proposed to reduce the temperature of rooms in India, by permitting cooled compressed air to escape from a safety-valve into the apartment to be cooled. But this method of employing compressed air is both inefficient and ancient, for the Marquis of Worcester, in the quaint language of the time in which he lived, alludes in his "Century of Inventions," to an "artificial fountain to be turned like an hour-glass by a child, in the twinkling of an eye, it holding a great quantity of water, and of force sufficient to make snow, ice, and thunder, with a chirping and singing of birds, and showing of several shapes and effects usual to fountains of pleasure." It is evident that compressed air was employed by the Marquis to produce the snow, ice, and thunder in this remarkable fountain.

The apparatus I propose to employ to obtain, as nearly as possible, all the cold resulting from the expansion of air with the least possible expenditure of force, consists of an ordinary double-acting force pump, a cooler formed of a number of copper pipes immersed in water, through which the heated compressed air passes, and is deprived of the heat resulting from compression, a receiver for the purpose of accumulating a quantity of compressed air, and a cylinder in which the air is permitted to expand. This cylinder is similar in form to those used in steam-engines, and the lap of the slide valve, together with a link motion, enables the supply of compressed air to be cut off at any part of the stroke. The pump and expansion cylinder are bolted down to the same bed-plate in a horizontal position, so that the position of the cylinder is in a direct line with that of the pump; by this arrangement the force of the expanding air is employed to assist in the condensation of fresh air. The action of the machine is this: air is compressed by the pump, forced through the copper pipes, and deprived of the heat it possesses in excess of the water in which the pipes are placed, conveyed to the receiver, thence to the expansion cylinder, where it is cut off at a certain part of the stroke. This part of the stroke, at which the supply of air is cut off, determines

the density of the air within the receiver. From the expansion cylinder the cold expanded air is conveyed away by the exhaust pipe to the room to be cooled. When used on board ship, the hold should be divided into compartments, into which must be packed the meat to be frozen ; it is not necessary that the contents of one compartment should be frozen at a time, as the air, though raised in temperature by contact with the meat in the first compartment, would still be colder than the air in the adjoining compartment.

The temperature of air is raised 4° Fahr. for every inch of mercurial pressure. Assuming that the pressure of one atmosphere equals thirty inches of the mercurial column, we have 120° Fahr. of latent heat rendered sensible by the compression into half its space of any body of air. If we remove this sensible 120°, and permit the compressed air to expand under a constant pressure of one atmosphere, its temperature will not be reduced to the extent to which it was raised by compression, that is to say, it will not fall from 80° to —40°. This is obvious, since, under a constant pressure, the temperature of any quantity of gas, to which heat cannot be communicated, varies as its volume, and conversely. If the compressed air in expanding were permitted (by removing the constant pressure) to expand to its original volume, its temperature would fall to —40°, but, as the pressure is constant, it cannot assume that volume and its relative temperature. In order then to reduce the temperature of air at 80° to —40°, it would be necessary to render sensible more than 120° of latent heat by compression.

The experiments of M. Gay Lussac, since repeated by MM. Rudberg, Magnus, Regnault, and Pouillet, have afforded me the data for determining the volume of any gas at any temperature. They show that in any gas or vapour, under the same pressure, the increment of volume corresponding to 1° is expressed by the 490th part of the volume which it would have if reduced to the temperature of 32°. This co-efficient of the expansion of gases and vapours is not absolutely exact, since gases are subject to a small difference in their rates of dilatation, and the dilatation of the same gas is not absolutely the same at different pressures ; but the inequality and variation are so small, that I have not thought them of sufficient importance to be considered elements in my investigations. I have assumed that all gases and all vapours dilate uniformly, and in the same degree as atmospheric air.

Since the volume of air gas at 32° increases by the 490th part of its bulk for every rise in temperature equal to 1°, it follows that the volume of a cubic foot of air at 80° will be to that at 32° as 490 + 48 is to 490, and that the volume of a cubic foot of air at 32° will be to that at — 40° as 490 is to 490 — 72. Therefore a cubic foot of air at 80° will, by being reduced in temperature to — 40°, occupy a volume of only ·776 of a foot. Assuming that the capacity of the pump in the machine previously described is one cubic foot, and that it makes 120 strokes in a minute (the distance that the piston moves in one direction being one stroke), the quantity of air compressed in one hour will be 7,200 cubic feet, but the volume to which it will expand is to 7,200 as ·776 is to 1; therefore the 7,200 cubic feet of compressed air will, on expanding, only occupy a space of 5587·2 feet. As the quantity of heat abstracted from the air after compression is equal to the heat that would have to be communicated to the air after expansion, to make it assume its original volume, it follows that the force exerted by the 5587·2 feet of air (supposing such heat to be communicated) in expanding to its original volume, would be an exact measure in force of the cold produced. This force (assuming the atmospheric pressure to be 15 lbs. on the square inch) would be equivalent to lifting 3,483,648 lbs. one foot high, equal to 1·76 horse-power nearly, the power, less that representative of friction, necessary to drive the machine for one hour.

Assuming that 12½ cubic feet of air at 80° weigh 1 lb., the total weight of the air compressed would be 576 lbs. As the specific heat of air is to that of water as .24 is to 1, it follows that 576 lbs. of air at — 40° would equal 138·24 lbs. of water at the same temperature. Taking 140° as the quantity of latent heat to be abstracted from water at 32° to convert it into ice, 138·24 lbs. of water at — 40° equal 71 lbs. of ice at 32°, which would give 1704 lbs. of ice as the result of 24 hours' work with 1·76 horse-power.

In this investigation I have supposed the air employed to be perfectly dry, and therefore have not considered the variations in volume that would attend its use in its ordinary hygrometric condition.

Air containing moisture occupies a larger volume than when dry. The quantity of moisture with which any quantity of air can be saturated, the atmospheric pressure and temperature, and the pressure of the vapour of water being given, can be easily determined, since the pressure of a

gas is inversely as its bulk. When the barometer stands at 30 inches and the thermometer at 80°, the elastic force of the vapour of water being 1·010 of an inch of mercury, a cubic foot of air saturated with moisture, would, when dry, contract to 1669·824 inches. This shows that a somewhat different result would attend the use of moist air.

ART. V.—*The Introduction of Gold to, and the Formation of Nuggets in, the Auriferous Drifts.* By J. COSMO NEWBERY, B. Sc., Analyst of the Geological Survey of Victoria.

[Read 30th April, 1868.]

At the meeting of the Society in September, 1866, Mr. Chas. Wilkinson read a paper on the growth of nuggets, in which he stated that I was carrying out a series of experiments based on the very interesting discoveries he had made.

Before describing my experiments and their results, it may be well for me to give an abstract of the arguments used for and against the denudation theory and in favour of what seems to some a rather ludicrous idea—the growth of nuggets in the drifts.

Through the kindness of Mr. Ulrich, I have been able to read the latest ideas of the eminent chemical geologist, Professor Bischoff, from whom I shall freely quote.

That some portion of the gold found in the drifts has been derived from the quartz reefs at the same time that the reefs themselves were formed, there can be no doubt, but the absence of large nuggets in the reefs and the marked difference that exists between much of the drift gold and that from the reefs, tends to make us believe that some portion of it had some other origin or was transferred from the reefs to the drifts by some means other than by denudation. Even if we admit that the large nuggets may have been derived from the reefs by denudation—(for there is a theory that the reefs were much richer in the portions removed to form the drifts, than they are as they now exist)—we must remember that the nuggets consist of nearly the heaviest known matter, offering but a very small surface of attack, when compared with the other materials acted on by the same force and at the same time; it therefore appears strange that these

heavy masses should be found at such great distances from any known reef, as nearly all the large nuggets have been. Another point which attracts attention is, that they are sometimes found in the sand overlying the gravel, which is quite inexplicable, if they ever were in motion with the rest of the constituents of the drift, which usually have a regular arrangement from top to bottom. First clay, then sand and fine and coarse gravel.

These objections to the denudation theory are not easily explained away. And then comes the great fact that gold is contained in the iron pyrites which is found in the drifts, assuming the form of roots and branches of trees and also replacing the carbonacious matter of the other drift wood. Every sample of this pyrites that has been examined has been found to contain gold. In some instances in a quantity equal to forty or more ounces per ton, and this in samples in which no particles could have collected in crevices or cracks.

This proves that gold did exist in the meteoric waters which deposited the pyrites in tertiary times.

Based on these arguments, Mr. Selwyn, some years ago, advanced the hypothesis, "That nuggets may be formed and that particles of gold may increase in size through the deposition of gold from the meteoric waters percolating the drifts, which water, during the time of our extensive basaltic eruptions, must have been of a thermal, and probably of a highly saline character, favourable to their carrying gold in solution."

As Mr. Ulrich points out in his essay on the Mineralogy of Victoria, this view of the character of the meteoric waters in earlier times receives aid from the fact that on our western gold-fields only, where tremendous basaltic eruptions have taken place, all the large nuggets have been found, while on the eastern and northern fields, where basaltic rocks are wanting, or only of very limited extent, the gold is usually fine, and nuggets of more than an ounce in weight very rare.

That gold does exist in solution in some saline waters of the present day has been proved by several analyses, and Mr. Daintree found gold in solution in water taken from a mine in this colony.

Further proof of gold having been in solution at a comparatively recent date, I found when examining the pebbles of the miocene drifts; they are chiefly quartz, and are coated

over with manganiferous brown iron ore, in which I found gold, though I never could detect any in the pebbles when their surfaces were carefully cleaned.

What the gold salt was, whether a chloride, silicate, or sulphide, we have no means at present of ascertaining. And as it may have been in the same solution that deposited the pyrites, which probably contained its iron in the form of protocarbonate with sulphates, it was not easy at first to imagine any ordinary salt of gold existing in the same solution as a protosalt of iron; but this I find can be accomplished with very dilute solutions in the presence of an alkaline carbonate, and a large excess of carbonic acid, both of which are common constituents of mineral waters, especially in Victoria. This is true of chloride of gold, and if the sulphide is required in solution, it is only necessary to charge the solution with an excess of sulphuretted hydrogen; in this manner both sulphides may be retained in the same solution, depositing gradually with the escape of the carbonic acid.

Professor Bischoff has suggested the occurrence of sulphide of gold in meteoric waters, and by experiment he found that it was slightly soluble in pure water. Once formed and present in the water it is, like all other gold salts, easily decomposed. In an experiment I have made, the sulphide of gold was held in a solution by a small quantity of an alkaline bicarbonate. A cube of iron pyrites and a chip of wood were introduced, and in a few days small irregular grains of metallic gold were deposited on the pyrites. What part the organic matter took in the reaction is not clear, but the gold was not deposited in the absence of it.

In Mr. Chas. Wilkinson's paper, a series of experiments are described in which gold was deposited in the metallic form upon a nucleus, from a solution of the chloride by the reducing agency of organic matter, the nuclei being either gold itself, or iron, copper, and arsenical pyrites, galena, zinc-blende, sulphide of antimony, etc. Organic matter has long been known as an agent for precipitating gold in the metallic state from its solutions.

Rose states that oxalic acid precipitates it in metallic laminæ. This I have failed to produce. When boiled with a solution of chloride, I got purple and red precipitates, but when allowed to remain at the temperature of the air for some hours, a film of gold floated on the surface of the liquid, and

the bottom and sides of the vessel were gilded. Tartaric, citric, and other organic acids have much the same effect. With wood, bark, charcoal, and like substances, the reduction is much slower. No carbonic acid is seen rising, and the gold is deposited in the pores of the reducing agent, if the solution is dilute. But it was not known until the experiment of Mr. Daintree, and the following ones made by Mr. Wilkinson, that this deposit would take place on a nucleus, and be continued as long as gold remained in solution. If this action went on in the drifts, it would account for the greater purity of the gold and for the nucleus of brown iron ore so often found in nuggets and crystals. Strong solutions of gold immediately begin to decompose the pyrites and interfere with the regular deposition of gold. By a strong solution, I refer to one containing more than one grain of chloride of gold to the ounce of water. A weaker solution than this also decomposes the pyrites, but so slowly as not to interfere with the deposit taking place regularly; all the other sulphides are also decomposed. In the experiment in which galena was used as a nucleus, this decomposition was best marked. Somewhat more than a year ago I placed a cube of galena in a solution of chloride of gold, with free access of air, and put in organic matter: gold was deposited as usual, in a bright metallic film, apparently completely coating the cube. After a few months the film burst along the edges of the cube, and remained in this state with the cracks open, without any further alteration in size or form being apparent. Upon removing it from the liquid a few days ago, and breaking it open, I found that a large portion of the galena had been decomposed, forming chloride and sulphate of lead, and free sulphur which were mixed together, encasing a small nucleus of undecomposed sulphate of lead. The formation of these salts had exerted sufficient force to burst open the gold coating—which upon the outside had the mammillary form noticed by Mr. Wilkinson, while the inside was rough and irregular, with crystals forcing their way into the lead salts.

Had this action continued undisturbed, the result would have been a nugget with a nucleus of lead salts, or if there had been a current to remove the results of the decomposition; a nugget without a nucleus of foreign matter. If, instead of galena, we had had a piece of pyrites to start with, the decomposition would have gone on in the same way, but the result would have been brown iron ore in

place of lead salts. This decomposition gives a very simple means of accounting for the oxide of iron, so often found in the nuggets and crystals of gold, the latter especially, as shown by the experiments of the late Dr. Becker, by cutting them in halves, and by their established low specific gravity, and their loss in weight suffered in smelting.

Finding the brown iron ore of the miocene drifts contained gold, I was led to suppose that though I could not make gold deposit on it, I might succeed in making them deposit together, which was the case. I arranged a mass of sand with chips of organic matter in it, in a vessel, and slowly filtered through it a dilute nearly neutral solution of sesqui-chloride of iron, containing a few drops of chloride of gold, and as it passed through, repeated the dose. This continued for some weeks without any appreciable change taking place, but after some months thin bands of hydrated sesqui-oxide of iron began to form across the mass, about the centre, parallel with the surface. As they increased in size they assumed a botryoidal appearance, like the "ferro-manganese ore" which occurs in the quartz reefs, and in many parts were coated with a bright film of metallic gold. Every further addition of the mixed solution produced another layer of oxide and gold, so that in time it appeared stratified. If the gold had been continued alone after once having started its deposition, the result would have been the same as in the case of the decomposition of pyrites. On the other hand, if the iron solution was in excess after a deposit of gold had been formed, it would have produced what is so often found in the alluvial workings, a nugget coated with iron ore, commonly known as "black gold."

This mixed solution is one which we would not expect to find in nature, but there is no difficulty in supposing the transfer of gold with iron that would deposit as oxide, even, if we need to introduce carbonic acid. If a solution of sesqui-chloride of iron and chloride of gold are heated together, the whole of the gold, in a very finely divided state, with a portion of the iron as sesqui-oxide, is deposited in a brownish yellow precipitate.

Though the processes I have described will account for the formation of nuggets, it does not account for the appearance of the gold in pyrites. I have examined about 100 samples, in none of which do I find any tendency on the part of the gold to assume the form of a coating, it being usually in irregular grains, and small octahedral crystals, seldom to be

detected, even with the aid of the microscope, until nearly all the pyrites has been oxidized and decomposed. In a few exceptional cases pieces have been found projecting, but all tends to prove the priority of the deposition of the gold, and that instead of pyrites having formed a nucleus for the gold, the reverse has in the majority of instances been the case.

It may also have been the first to deposit in the drift wood, for in all the experiments by Mr. Wilkinson and myself the organic structure became so impregnated with gold that when ignited (so as to burn off the undecomposed organic matter) a golden model remained. Flies, which fell into some of my experiments, and were useful in keeping up a supply of fresh organic matter, became so thoroughly impregnated that in some cases the finest hairs on their backs and legs were to be seen in bright gold after ignition. Conditions such as these (before ignition) would be very favourable to the formation of pyrites, offering to a ferruginous water containing sulphates, a reducing agent and congenial nuclei for the crystals to form on. Crystalline gold is very easily made, by simply introducing a chip of wood into a solution of chloride of gold, containing five or six per cent of the salt. The crystals are first seen on the surface of the liquid as a thin film, which, as it grows heavier, falls to the bottom, where it assumes a moss-like appearance; if this is examined under the microscope, it will be found to be a network of octahedral crystals resembling very closely the gold crystals from pyrites. These crystals have been repeatedly made, in a carefully closed vessel, so that no dust might enter, and falling on the surface form nuclei for them. With these crystals I sometimes found irregular pieces of gold, some in places showing planes of octahedrons. In these experiments, as in all the others, organic matter is necessary, the action ceasing when it was removed, starting again immediately with a fresh addition.

These experiments are based on the assumption that the gold exists in the pyrites on the metallic form, and not as sulphide, as has been supposed to be the case by some. Mr. Daintree got gold in solution by digesting some of the pyrites from Clunes in sulphide of ammonium, but I have always failed to prove the presence of it as negative evidence against it. I have the result of experiments made by digesting the pyrites with an oxidizing agent, washing the residue free from impurties, weighing the gold and comparing the result with that got from a portion of the

same sample made by the ordinary fire assay, and finding that they agreed.

If sulphide of gold has existed in the metallic waters, we might expect in some cases to find it, but, as before noticed, it is so easily decomposed, that it is not possible for much to have resisted the heat caused by the basaltic eruptions.

I have experiments now in progress which contain the sulphides of iron and gold in solution, but up to the present time without any result, in this direction. Like some of the others I have spoken of, they may require a year or more to accomplish the end wished for.

Professor Bischoff suggests silica as the medium for the transmission of gold to the quartz reefs, gold, as he points out, certainly has a great affinity for silica, always being found in connection with it in mineral veins in the drifts, and even in the pyrites, where I have always found silica as grains, and minute nearly perfect hexagonal crystals; the occurrence of which I have always been at a loss to account for.

The Professor's experiment is a very instructive one. He reports it as follows :—On adding to a solution of chloride of gold a solution of silicate of potassa, the yellow colour of the former disappears. After half an hour the fluid turns blue, and in time a gelatinous dark blue precipitate appears, which adheres firmly to the vessel. After the lapse of some days moss-like forms are to be seen on the surface of the precipitate like an efflorescence; on exposure to sunlight, no reduction takes place, but after the lapse of some months, if the precipitate is allowed to remain undisturbed under water, a decomposition takes place, and in the silicate of gold appear minute partly microscopical specks of gold.

If this is the method by which the gold reached the lodes, as the Professor argues, the origin of the silica may also be that of the gold. The origin of the former we now believe to be the silicates of the rocks, by the decomposition of which by mineral waters the silica is conducted to the lode cracks. In these silicates we have therefore to look for gold; and it is possible that it is contained in them as silicate. To prove this is almost impossible, for if we even found the gold it would be in a quantity too small to determine whether it was in combination or not.

Silicate of gold is extremely insoluble in water, but if we assume that its solubility is in the same ratio to the solubility of silica as the gold of even our richest reefs is

to the silica in the reef, we will find no difficulty in admitting that silicate of gold may exist in solution.

In several instances an amathistine colour has been observed, both in the quartz reefs and in the "washdirt" of the drifts. Mr. Aplin tells me that he observed it in a lead of washdirt near Beechworth. When pieces of the clay so coloured were first broken out no gold was to be seen; but after exposure to the light and air for a short time the colour disappeared, and it was seen to be full of very finely divided gold. Mr. Ulrich also tells me that this colour and phenomena were observed by a Mr. Clement, a successful quartz miner, of Maldon, who described having found dark blue clayey bands in the centre of a quartz reef, some ten feet thick, at a depth of about seventy feet from the surface. The colour in this case, as in that reported by Mr. Aplin, disappeared when exposed to air and light, and gold became visible. It is to be regretted that no chemical examination was made, as there was undoubtedly a compound of gold present.

Be this as it may, there can be no doubt that nearly all the native sulphides contain gold, especially those which also contain silver. I have found it with this metal in every sample of iron, copper, and arsenical pyrites galena, sulphide of antimony and zinc blended, which I have examined from the rocks of this colony; and Dr. Percy proved its existence in every sample of galena he examined, even though they contained little or no silver. Bischoff, in reviewing facts like these, says that it has been repeatedly proved that in the decomposition of ore lodes, the silver takes part in the oxidation processes, and is removed in soluble combinations. If such ores are auriferous, and after such a decomposition the lodes undergo mechanical destruction, the gold will, as it is in a very minute state, be carried off with the results of the decomposition. The argentiferous character of the native gold, and the auriferous character of native silver, show that though one metal passed into a soluble form and the other remained metallic; the separation was not complete.

In this very minute state gold may possess properties differing from those which it has when in mass. Iron, for instance, when reduced by hydrogen from the oxide, has such a great affinity for oxygen, that, if dropped through the air at the ordinary temperature it takes fire, whilst ordinary iron filings, under similar circumstances, are not affected.

It is therefore possible that gold, under certain circumstances, may, by the presence of silica in solution, become disposed to combine with oxygen, and then to form with the silica a silicate of gold.

If further experiments prove that alkaline silicates favour the solubility of silicate of gold, this silica theory will be open to but few objections, and the difficulties to impede our progress in solving this most interesting problem in chemical geology will be greatly diminished, as it will not require the presence of strong chemical agents, which are not to be found either in the rocks, or in the meteoric waters percolating through them.

Art. VI.—*Aneroid Barometers, and the Methods of Obtaining their Errors.* By Mr. R. L. J. Ellery, President.

[Abstract, Read 11th May, 1868.]

In this paper the President referred principally to the construction, mode of using, and the correction of errors of aneroid barometers. He pointed out the great utility of these, both as scientific instruments and domestic weather-glasses, as well as of their great value as marine barometers. He drew attention to the absurdity of the ordinary printed words on barometers, as being quite inapplicable, at all events to this climate, and stated that the point marked "stormy," namely twenty-eight inches, was seldom or never reached in these latitudes, and that our most violent storms occurred with a much higher barometer. He then gave the following series of directions, for the guidance of those using the barometers as a weather-glass in Melbourne and its neighbourhood:

It should always be remembered that the barometer foretells *coming* weather rather than indicates weather that is *present;* that the longer the time between the signs and the change foretold by them the longer such altered weather will last; and on the contrary, the less the time between a warning and a change the shorter will be the continuance of such predicted weather. If a barometer is about at its ordinary height—near thirty inches at the sea level—and is steady or rising while the thermometer falls, S.W., S., and S.E. winds may be expected. On the contrary, if a fall takes place with a rising thermometer, wind and

rain may be expected from the N.E., N., and N.W. Exceptions to these rules occur when southerly winds with rain and hail are impending, before which a barometer often rises on account of the direction of the coming wind alone. When the barometer is rather below its ordinary height, say down to 29½in. at the sea level, a rise may foretell less wind, or a change in its direction towards the south, or less wet; but when it has been very low, say about 29in., the first rising usually indicates strong wind, at times heavy squalls, from S.W., S., or S.E.; after which a gradually rising glass foretells improving weather, if the thermometer falls; but if warmth continue, the wind will probably back, and more N. or N.W. wind will follow, especially if the rise of the barometer has been sudden, and considerable, or if it is unsteady. The heaviest southerly gales happen soon after the barometer first rises from a very low point. Indications of approaching change of weather and direction and force of wind are shown much less by the height of the barometer than by its falling or rising, but a height of more than thirty inches at the sea-level is indicative of fine weather and moderate winds, except from S.E. occasionally, whence it may blow strongly with a high barometer. A rapid rise of the barometer indicates unsettled weather, a slow movement of some duration the contrary, as does likewise a steady barometer. A rapid and considerable fall is a sign of stormy weather and rain; alternate rising and sinking, or oscillation, always indicates unsettled disagreeable weather. The greatest depressions of the barometer are with gales from the N.E., N., or N.W.; the greatest elevations with wind from S.W., S., or S.E., or with calms. Though the barometer generally falls for a northerly and rises for a southerly wind, the contrary sometimes occurs, in which case the northerly wind is generally fine with dry weather, and the southerly wind violent with rain and hail. A barometer begins to rise considerably before the conclusion of a gale, sometimes even at its commencement. It falls lowest before high winds, but frequently sinks very much before heavy rain. Instances of fine weather with a low barometer occur, but they are always preludes to a duration of wind or rain, if not both. Sometimes severe weather from the northward of short duration may cause no great fall, because followed by a duration of wind from the southward; and sometimes the barometer may fall with southerly winds and fine weather, apparently against these rules, because a

continuance of northerly winds is about to follow. A very high barometer and comparatively low temperature is generally followed by a gentle breeze from S.E., except in summer, when the wind may be fierce from that quarter; with the barometer falling rapidly, the wind will veer round to N.E., and N., accompanied in winter by rain, fog, or dew, and increasing in force; in summer generally a hot wind will set in; unsteadiness in the barometer indicates the shifting of the wind to N.W., in which quarter the barometer is then lowest; after this, with a rapid rising barometer, the wind will shift to W., W.S.W., and S.W., accompanied generally with heavy rain and thunder and lightning; with a still rising barometer the wind decreases in force, inclining towards south, until it has again reached its maximum in S.E. Whenever it blows from N.N.W. or N.W., the barometer, if still falling, should be frequently observed, and as soon as it becomes steady, and the wind is apparently lulling, the shifting of the wind towards S.W. may be expected, which usually takes place with great violence. Gales from S.E. are frequent in summer, and generally commence with a high barometer and light variable winds and calms; towards the height of the gale the barometer falls but slightly, and the wind is then gradually dying away. A steadily falling barometer, with fine weather and light winds from N.N.E. after such a gale, is generally followed by heavy westerly squalls, with much rain and hailstones.

Art. VII.—*An Improved Method of Preserving Wines, Spirits, &c.* By A. K. Smith, Esq.

[Read 28th May, 1868.]

Mr. President and Gentlemen,

The subject of my paper this evening bears chiefly upon a colonial industry of rapidly increasing importance, namely, the manufacture and preservation of wine; but the principle to which I have now to direct your attention may be applied with beneficial results to the preservation of any other liquids in the cellar or on draught, so far as preventing contact with the external air, where such contact is liable to injure the quality of the liquid.

My knowledge of the manufacture of wine is but limited, and at most, theoretical. Having been informed, however,

by the manager of my vineyard at Sunbury, and by other practical vignerons, that a great drawback to the proper manufacture of wine was the difficulty of excluding the air from the casks when the bulk or volume became reduced by absorption, evaporation, condensation, or any other cause, I directed my attention to a simple and inexpensive, though effectual mode of accomplishing this desirable object.

Dr. Guyot,* an eminent authority on the culture of the vine and winemaking, in speaking of the manufacture and the keeping of wine, makes the following remarks :—

"Filling up the casks during the latent fermentation (secondary fermentation).

"If the filling up is indifferent or useless during the initial or primary fermentation, it becomes necessary when that fermentation is accomplished or suspended, and that the latent fermentation replaces it to exist alone henceforward. The filling-up must be done at least twice a week till the next racking off, and with wine of the same age and quality as in the cask. Afterwards, filling-up is done once a month till the next racking-off, and then once every three months till the sale or the bottling off.

Again, speaking of the "Summary of the precepts applicable to the keeping of wines," Dr. Guyot says :—

"It was necessary for me to show the principal influences of the general modifying agents on wines before giving the last observations as concerning the care to be taken after the first fermentation ; a few words will now be sufficient. It will be necessary to observe the following rules, namely :— To fill up completely all the vessels containing wine, firstly, every two or three days, then every week, and every month, and lastly four times a year, and always with the same sort of wine, or wine of the same nature.

"If there is one cask of old wine for which no similar kind can be obtained to fill up, the ingenious process recommended by M. de Mouny in his book of the vigneron is practised. Stones which do not effervesce when put in vinegar or acids are put in the cask, but those stones must be first well boiled in water, and washed afterwards in cold water."

The method here alluded to, of putting stones in a cask to

---

* Culture of the Vine and Wine Making, by Dr. Jules Guyot. Translated by L. Marie. Melbourne : Walker, May, and Co., 1865. pp. 72, 87.

increase the volume, and so exclude the air, is, in my opinion, one of those rule-of-thumb plans that, in the absence of any better method, may partially answer its intended purpose, but requires constant care and attention to be of any service whatever.

An acquaintance of mine recently informed me that, before he knew anything of wine-making, he had tried this plan, and the result was, that a small cask of fair wine was changed into bad vinegar, a result so totally unexpected that he thought the great chemical change was due to, or caused by, the quality of the stones that he had put into the wine, rather than by the careless way in which he had managed the operation, as he admitted that the cask was only half full, and the bung left out of it on different occasions for a considerable time.

How, or why, or to what extent, the wine is affected by the presence of air in the casks I will leave others to decide; but as it is admitted by all that its presence is objectionable, I shall now proceed to describe my patent improved method of keeping wines, ales, or other liquids free from contact with the air, and I feel assured it will not be the less interesting to you when I state that it is inexpensive, self-acting, continuous in its action, and thoroughly efficient.

I have here a cask, made of crystal, so that by means of its transparency the whole *modus operandi* can be observed. It is filled with coloured liquid to represent wine. This vessel, having the opening or bung-hole at the upper end, I have fitted the bung in that position; but, under ordinary circumstances, it would, of course, be applied to the top side of the cask.

You will observe that two small stopcocks are screwed into the bung, both of which communicate with the inside of the cask. To the end of one of these stopcocks, marked *A*, is attached an elastic watertight bag or sac, which may be made to contain any quantity, from half a gallon to twenty gallons and upwards. This bag before inflation is passed through the bung-hole of the cask to which it is applied, and hangs loosely in the interior thereof. A second stopcock, marked *B*, opens freely into the interior of the cask. The small water cistern, funnel, and tubes, comprise the whole apparatus, and the mode of action is as follows.

Supposing the cask to be full of liquid, as it now is, the cistern is placed at a slight elevation above the cask, the

maximum height being regulated by the length of the flexible tube attached thereto.

It is of importance thus to limit the length of the tube, for if the cistern be raised too high the hydrostatic pressure might force out the bung, or burst the cask. A quantity of clean water is put into the cistern, and the stopcock *A* is opened, leaving free communication between the cistern and the elastic sac in the interior of the cask. Any quantity of liquid may now be drawn from the cask (limited, of course, to the capacity of the sac under a given pressure), and the cask will still remain full, that is, the space occupied by the liquid so withdrawn is replaced by an equal bulk of water in the interior of the sac. It will thus be perceived that any loss by absorption, evaporation, condensation or any other cause, is simultaneously compensated by hydrostatic pressure, and that the cellarman can at all times, and with impunity, sample his wine without the use of vent pegs or refilling the cask.

As the elastic sac has necessarily a capacity less than that of the cask itself, it occurred to me, when thinking over the subject, that in wine-making establishments it would be necessary to have the power of discharging the water and filling up the cask without removing the bung, leaving the whole apparatus ready for action *de novo*.

This can readily be done, simply and effectively, also by hydrostatic pressure, and for this purpose the stopcock marked *B*, a small funnel, and a piece of elastic tube, are necessary, the action being as follows :—

Remove the cistern from its elevation and place it upon the cask itself; attach the flexible tube with funnel at the other end to the stopcock *B*, raise the funnel to the extent that the length of the tube will allow, and pour the required liquid into the funnel. The result is, that the water contained in the sac is expelled by hydrostatic pressure into the cistern again, the sac itself collapses and leaves room for the liquid so poured in. The cistern can then be replaced, and no further attention will be required till the cask requires to be refilled, when the same operation may be repeated.

The elasticity and capacity of the bag, before use, is ascertained by the hydrostatic pressure ; and the knowledge of this capacity will enable the cellarman to determine what quantity is required to fill up the cask, the time for doing so being indicated by the cask itself, as when the bag is

fully distended no more wine or other liquid can be drawn off.

In conclusion, with respect to this apparatus being self-acting and efficient, you are now in a position to form your own opinions; and with regard to its expense, this will, in a measure, depend upon the number or size of the casks to which it is applied. I may mention, however, that while each bung requires to be fitted with two stopcocks, one cistern may be made to supply all the casks in the cellar, and the small funnel and elastic tube being portable, and only used occasionally, will answer for filling up any number of casks. It is scarcely necessary to add, that all the metal coming in contact with the wine should be tinned or silvered.

As a simple invention, I have protected it in this and the adjacent colonies, with the object of at once taking out patents.

Art. VIII.—*On a Plan for maintaining True Time throughout the City, and on the Railways.*

By Mr. R. L. J. Ellery, President.

[Read 8th June, 1868.]

I think everyone will admit that it is desirable that clocks exposed for public reference, or for the regulation of railway or other traffic, should be kept absolutely correct, or at all events, as nearly correct, and consequently alike in their indications, as possible. In this age, time is money to most people; and the value that may be attached to a single minute in many cases, would, I have no doubt, be more than the whole cost of providing the means of maintaining one absolute and reliable measure of time throughout the city. That the clocks which are exposed for public reference in our streets, in the shop windows and at the railway-stations, do differ in their indications, and often to a serious extent, is well known. How many a punctual business man on his way to the railway or to an appointment gets perplexed at the varying value of the precious period yet at his disposal, as he consults various clocks' faces on his road, each professing to indicate true time.

We may not be quite so bad as Paris was a century ago, where Delambre says the same hour could be heard striking in the different parts of the city over at least half-an-hour of

time, but if all the clocks for public use in Melbourne told their own tale with a brazen tongue, we should be surprised at the long period that would be embraced between the striking of those that are fast and those that are slow. Some of our railway clocks indeed appear to be of Captain Cuttle's watch class, which if put on ten minutes in the morning, and back a quarter of an hour in the middle of the day, would be equalled by few, and excelled by none.

The head quarters of all time measurements and regulation are the various public and private observatories which now exist in almost every part of the civilized world. It is a duty of the first and greatest importance in such institutions to obtain and maintain true time with the highest precision, and wherever one has been established the first practical benefit it confers on the public is to afford precise means for the regulation of time. This has usually been done by means of periodic signals indicating some prearranged instant, such as for instance the drop of a time ball, or the flash or boom of a cannon at one o'clock, which enables those so disposed to determine the errors of their timekeepers and to set them right. It would be inconvenient, however, and even injurious to good clocks to set them right every day, and to obviate this it used to be the custom of some clockmakers in London to place a card showing the error of the clock at the time the signal was given. This, as far as the general public was concerned, was almost an useless compromise, for, to be used as a clock exposed for public reference is intended to be used, it should show the right time with its hands without the necessity of a mental calculation. It appears, therefore, that the periodic method of regulating time, although admirably adapted for obtaining errors and rates of superior clocks and ship chronometers, does very little towards the attainment of that horological millennium which I have assumed to be so desirable, and that a method by which the various clocks exposed for public use could be made to go in unison seems to be the only one by which the end required is likely to be reached. It was the necessity of some reliable means for obtaining true time, for the determination of the errors and rates of chronometers belonging to the fleets of merchantmen which then filled our port, and for public purposes generally, that first brought about the establishment of our Observatory in 1853; and now there are few observatories in the world that have such facilities as it possesses for successfully acomplish-

ing any method of public time regulation that may be adopted, possessing as it does the most perfect appliances in the world for such purposes, and among them the magnificent clock, whose performance was declared by the jurors of the late Paris Exhibition to be quite unprecedented.

With such facilities, I should be to blame if I did not avail myself of every opportunity to make them render all the practical service possible to the community; and I am now about to propose a plan for the regulation of public time, which has already been adopted in Liverpool, Glasgow, and Edinburgh, and I think in some parts of London, with great success, economy, and public satisfaction. This plan consists in controlling electrically, by currents from a standard clock, all clocks that may be placed in electric circuit with it, and the method of doing it comprises the laying down of a "time main," and laying on the supply to any clock or establishment requiring it, almost as you would gas. About twenty years ago, Mr. Bain, in London, invented a clock which went by electro magnetism, instead of by a weight or spring; the galvanic current necessary to drive it was very small, and the clock went uncommonly well, but in common with all clocks that depend on a galvanic battery for their motive power, it was liable to failure, and by experience it has been found almost impossible to obviate this uncertainty; this and allied electric clocks, have never, therefore, come into general use. The ingenious contrivance invented by Bain, however, for driving a clock by electricity, has been most cleverly modified and adapted by Mr. Jones, of Chester, for controlling pendulum clocks driven by the ordinary weight or spring, which it accomplishes with the utmost precision and regularity, at a very slight cost, and above all, involves no special clocks, nor any great alterations in the clocks it is desired to control.

The plan is this—the Observatory clock is furnished with a second wheel on the escape-wheel arbor, which has thirty teeth, each tooth of which in passing brings a pair of light springs in contact for about 1-10th of a second at every escape; but there are two sets of springs, and one set is brought into contact at the even and the other at the odd seconds of the clock. These springs are insulated one from another, and are armed with platina at the points of contact. We will call the springs *A* and *B*, and the points they touch, common to both, *C*: so that at the even second *A* touches *C*, and at the odd *B* touches *C*. A galvanic battery with 2 (or

multiple of 2) cells is now arranged, so that the positive pole of one cell is connected with *A*, and the negative of the other with *B*; the other positive and negative poles are joined together and connected with *C*. Now as the clock goes, and the springs *A* and *B* are alternately brought into contact with *C* each second, an alternately positive and negative current will flow along the wire to *C*. Any length of wire may now be interposed between the contact piece *C* and the united poles of the battery, and this wire will form the time main.

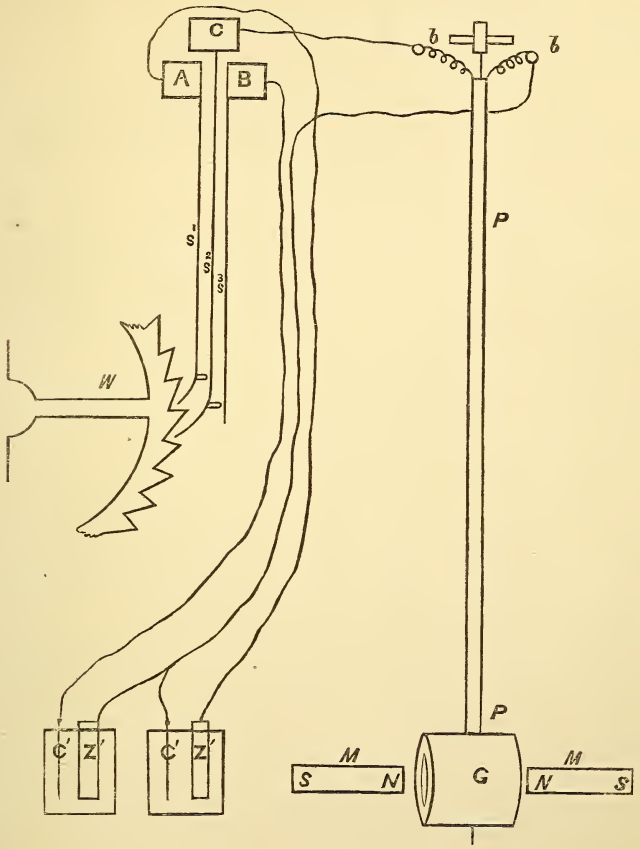
If we wish to lay on the supply to any other seconds pendulum clock to control it, the following arrangements have to be made. A pendulum bob, formed of a hollow bobbin of covered copper wire, has to be fitted on to the pendulum instead of the one hitherto used in the clock to be controlled. The two ends of the copper wire are led insulated up the pendulum-rod to the suspension-spring, where they are coiled into spirals (so as to offer no resistance as the pendulum swings) and made to terminate in two binding-screws on the clock case. Two permanent magnets have now to be fixed in such a way that as the pendulum swings the hollow ends of the bobbin just enclose the ends of the magnet at the end of each oscillation. The time main is now led to one of the binding-screws holding one end of the pendulum wire, and led on from the other screw to other clocks or to the ground, which will form the return wire.

Now supposing the circuit complete and the Observatory clock going, it sends its alternating positive and negative currents through *C* along the time main and into the pendulum, and by a well-known law converts the bob into a magnet with two poles at every current, and as the currents are alternately positive and negative, the poles of the bob will also alternate. Suppose we set the pendulum swinging, and it arrives at the end of its swing to the left with a north pole, it meets with the *N* pole of the magnet, which tends to repel it, while the opposite end of the bob being S. is attracted by the right hand magnet as it swings to the right. The right side of the bob is now N., and is again repelled by the magnet on the right until, in a very few seconds, it commences to swing so that the ends of the bob are always S. as they approach the N. poles of the permanent magnets; and once oscillating in this manner, it is, so long as the currents flow properly from the standard clock, a difficult thing to make the controlled clocks go any other way

except in exact unison with the controlling one. Even if its tendency was to lose or gain many minutes a day it cannot do it, and it would continue to show the same second as the Observatory clock so long as the currents along the time-main continued. The great advantage of this method is that even should any failure take place in the Observatory clock or in the currents, the clocks would continue to go as well as before adopting the control, but being governed only by their own pendulums would be liable to the losing or gaining rate belonging to them.

To carry this method into practice in Melbourne it would be necessary to lead another wire on the telegraph posts already erected to such parts of the city as it is likely to be required—certainly to the railway stations. Post-office, Telegraph-office, and, perhaps, other public buildings. This would not cost much—a couple of hundred pounds would probably do it for the whole city. A small rent for the use of the time supply could be charged, which I feel confident would be readily paid, and which would render good interest on the outlay. The new pendulum bobs and magnets could be easily made and fixed by any intelligent mechanic, according to a pattern which would be generally adopted. Those using the control would have nothing to do with batteries, nor would they have any trouble beyond keeping the wires intact.

If this plan should be carried out, and I hope and believe it will, we should, instead of the state of public time-keeping I alluded to at the commencement, have all the clocks controlled, showing identically the same time, and all correct to a second. In Glasgow, as an extra security to the public, it is made a *sine qua non* that those using the supply should have a small, simple, galvanometer beside their clock, which shows by right and left deflections of its needle the alternating currents, and also by an omitted deflection at the sixtieth second of each minute, if the controlled indicates the same second as the Observatory clock. The heavy two seconds pendulum of large turret clocks can be just as readily controlled by the same main, by a different disposition of the permanent magnets. I am not aware that any method of controlling half seconds pendulums in this manner has yet been devised, but I am now engaged in some experiments on controlling, and I think a method applicable to half seconds pendulums, with the same currents, can be arranged.



W part of the 30 teeth wheel on the escape wheel arbor; s^1 s^2 s^3 the contact springs; *A B C* the spring blocks; *P P* the pendulum; *b b* binding screws at the controlled clock; *M M* magnets; *G* the hollow coil forming bob of pendulum; *C'Z' C'Z'* the two cell galvanic battery.

ART. IX.—*Speculations of the Zodiacal Light,* a paper by MR. T. E. RAWLINSON, of Belfast, was read 25th June, 1868.

ART. X.—*On Colonial Gems.* By REV. J. J. BLEASDALE, D.D.

[Read 25th June, 1868.]

MR. PRESIDENT AND GENTLEMEN,

I need scarcely remind you that already on several occasions I have brought under the notice of this learned society the results of my studies of Victorian, and other Australian gem-stones. To night I propose to resume the subject, and bring my lists a step or two nearer to completion. I am happy to say that I have quite a number of new and interesting matters to show you. They are new and interesting, both as regards several of their varieties and the district where they have been obtained.

I have no exact knowledge of the locality whence they came, that is to say, not within a few miles, but most of you may be aware that prospecting for ores of tin has been going on in the creeks, about Berwick for some time—and it seems most likely that some of the prospectors dropped upon the spot which yielded them.

In my former reports I have mentioned that a Victorian ruby had never been met with by myself. I wondered at it, the more so as Barklyite (an opaque ruby-red corundum) is found at Beechworth, and Mr. Ulrich had assured me he had seen one. The Rev. Mr. Clarke, of Sydney, showed me a large quantity obtained by himself, when examining the granite formations near Armidale, in New South Wales. I had also seen and examined one or two reported to have been brought from New Zealand. To night, however, I shall be able to settle the question of their occurrence in Victoria, beyond a doubt.

These of my present notice, specimens of which I lay before you, were most kindly placed in my hands by my friend, Mr. Crisp, of Queen-street. He got them from Mr. Henty, who really owns them, and in the vicinity of whose station, below Dandenong, they were found. They are interesting from many points of consideration. The first blue sapphire ever found in Victoria was got by Mr. Crisp

out of the gizzard of a wild duck, bought in Melbourne. This was told me by him a dozen years ago.

For a long time after the circustance mentioned to me by Mr. Crisp, nothing was known or heard of sapphire being found within a hundred miles of Melbourne. Then Mr. Ulrich informed me he had found a ruby, when examining sands from the creeks about Mount Martha and Mount Eliza—not very far from the place where were found those which I now exhibit. Two years and more ago, when making a collection of gem-stones for the Intercolonial Exhibition, I examined in a cursory way the Dandenong, Berwick, Tubba Rubba, and other creeks to the south-east of Melbourne, and in several places found in the sand and drift very pretty crystals of blue and greyish blue sapphire, and a few small zircons. Later on I saw a rather large lot at the Geological Survey offices, which Mr. Selwyn informed me had been brought from near Berwick. There is no wonder, then, at Mr. Crisp having met with a specimen in the gizzard of a wild duck; especially after what we know of the district, and when we recollect that at that time the supply of wild fowl was derived almost wholly from the Mordialloc and Dandenong country.

It is now an incontrovertable fact that the real Oriental ruby, of good colour and merchantable size, occurs within forty miles of Melbourne. What may come out of this no man can conjecture, but here are at once the fact and the evidences thereof. But not alone on the precious ruby, now more precious than the diamond, have I to say a few words to-night. I have here quite a lot of the Oriental amethyst—one of the most rare of all gems; a number of the Oriental emerald, the green sapphire, and also of the Oriental topaz and the Oriental aquamarine. As to zircons, they were found mixed up with the other things in the sand, but were of no value nor interest. I abstain, as I always have done, from loading any notes of mine with heavy scientific formulæ, matters which any one may find *usque superque* in books. Yet, for fear any outsiders might run off with the idea that I have been wanting in the scientific details necessary to render my results reliable, I may say I have subjected them to all known tests—both chemical and optical—of their purity, and am quite satisfied. Moreover, for fear of any controversy hereafter arising, I would respectfully say that I went over the least known of these new discoveries with Mr. Selwyn and Mr. Ulrich, and that we left no severe test

unapplied ; and that, in every instance, I am proud to say their observations confirmed my own. They confirm me in adding to the catalogue of our Victorian gems actual specimens of ruby, the priceless Oriental amethyst, the Oriental aquamarine, the Oriental topaz, and, perhaps, also the Oriental chrysoberyl, *i.e.*, the corundum one. What more may soon turn up, and how much I anticipate from the evidences in my possession, it might be folly to speculate upon. But thus much we are safe in assuming, and in displaying an honest pride in—that as yet no one country on the broad earth has yielded such an assemblage of varieties of rare and precious gems as Victoria. I am proud of it. It looks as if this country had been ordained to be a sort of a synopsis of the world. Here is a home for all animals — the tropics, in vegetation, are within 100 miles of Melbourne ; and in the mineral kingdom, the diamond of India, Ceylon, Brazil, and Siberia, is found at Beechworth ; the blue sapphire of Ceylon is found, in fine large crystals, commonly ; the ruby has now been brought before you this night ; and another form of sapphire, as yet new in Australia, the Oriental aquamarine, and also for the first time Oriental topaz ; and the Oriental chrysoberyl, as far as colour goes, that is, the sapphire of the exact chrysoberyl tint. As to the Oriental emerald, that I have brought before you already ; yet it is pleasing to have found fine specimens of it quite close to the city. I have found and exhibited beautiful specimens of tourmaline and aquamarine, both Victorian and South Australian. The one thing now wanted is the emerald. My friend, the Rev. Mr. Clarke, of Sydney, a name venerable in geological and minerological science, found it in New South Wales ; but we yet want it in Victoria to make this perhaps the most complete and unique country on earth in gem minerals. I need not here fall back on my previous reports, as they can be found in our Transactions. But though we may not have yet found the very finest in their several kinds, I think we may modestly—proudly, if you like—challenge the world for *varieties* of the various gem classes and families ; and that is something to say for a country whose resources are only now beginning to be discovered.

When bringing under your notice collections or single specimens of Victorian gem-stones, I have almost always to point out the obscurity of their crystalline structure. On the present occasion I have to call your attention to some-

thing more than the absence of crystalline forms in their entirety—or the rolled and water-worn appearances in this Berwick discovery. They differ wholly from any I have seen heretofore. There is no sign of their being water-worn ; and where a piece shows a solid angle, or where a crystal is complete—as a few of the blue sapphires, rubies, and one or two of the Oriental amethysts are—it is most perfect. The characteristic appearance of the collection, taken as a whole, is that of splinters—as if they had been broken with violence out of the hard formation that originally contained them—and that they had been left ever since in a state of quiescence. Ordinarily speaking, I should say they cannot have been washed very far from their original situs. And the granite formation and the old basalt through which the Berwick Creek and its tributaries flow would seem to be their native home. No doubt ere long much more will be heard about both the district and its gem beds.

ART. XI.—*Description of a Clock made for the Lobby of the General Post Office, Melbourne.* By MR. R. L. J. ELLERY, (Government Astronomer), President.

The President gave a description of a new clock he had designed for the lobby of the new Post Office, and which had lately been constructed by Mr. Gaunt of this city. The clock has two dials, one in the lobby over the centre of the staircase, which was four feet diameter, and showed a seconds hand as well as hour and minutes hands ; the second dial was in the great hall, and had a smaller dial showing no seconds hands, the leading off or connecting shaft being carried through the wall dividing the lobby from the hall.

The chief features of interest were the escapement and the excellent and workmanlike manner with which the works have been constructed, more especially as the requirements rendered a peculiar arrangements of parts necessary. The escapement was that known as Denison's detached gravity Remontoire which possesses the great advantage of always giving exactly the same impulse to the pendulum independant of any irregularities of the friction of the train, and in fact renders any great finish or precision of the train unnecessary.

The President pointed out that by the adoption of this admirable kind of escapement the construction of the best Turret Clocks was rendered far more simple than was generally imagined, and quite within the province of the engineers' workshop; he hoped that the Turret Clocks required in the colony would be constructed in Melbourne for the future. Photographs of the works were exhibited, and, in reply to questions on the subject, Mr. Ellery sketched and explained the principles of the escapement used.

STILLWELL AND KNIGHT, PRINTERS, COLLINS-STREET EAST, MELBOURN .

TRANSACTIONS

AND

PROCEEDINGS

OF THE

Royal Society of Victoria.

PART II.—VOL. IX.

Edited under the Authority of the Council of the Society,

BY

THE HONORARY SECRETARY, THOMAS H. RAWLINGS.

THE AUTHORS OF THE SEVERAL PAPERS ARE SOLELY RESPONSIBLE FOR THE SOUNDNESS OF THE OPINIONS GIVEN AND FOR THE ACCURACY OF THE STATEMENTS MADE THEREIN.

MELBOURNE:
STILLWELL & KNIGHT, PRINTERS, 78, COLLINS STREET EAST.
Issued January 1869.

AGENTS TO THE SOCIETY.
WILLIAMS AND NORGATE, 14, HENRIETTA STREET, COVENT GARDEN, LONDON.
To whom communications for transmission to the Royal Society of Victoria from all parts of Europe should be sent.

PREFACE.

The Editor has much pleasure in submitting to the Members of the Royal Society the second part of Volume IX., bringing the Transactions and Proceedings to the close of the year 1868.

The papers are of a varied character, and of some value as an index to the progress of Science in the colony. The views entertained by the individual members on many of the topics brought under discussion, and duly recorded in the proceedings, will be found worthy of consideration.

Arrangements have been made by which the convenience of members contributing papers will be extended, and facilities afforded for more efficiently working the Society. It is therefore with confidence the Editor looks forward to the Session of 1869 for increased activity in every department of Science, and trusts the future publications of the Society will bear testimony that this expectation has been realised.

A Catalogue of the Library, and a list of the Members and Societies that the Royal Society of Victoria is in Correspondence with, will be found appended to the proceedings.

The work of the EDITOR has been limited to the very narrowest point, but what time and labour he has expended over the present volume, in addition to the duties imposed on him as HONORARY SECRETARY he has cheerfully bestowed, in the hope that the prosperity which must inevitably attend the colony may be participated in by the Royal Society of Victoria.

MELBOURNE,

New Year's Day, 1869.

CONTENTS OF VOL. IX.

		Page.
Preface		v—vi
President's Address		1—21
Art. I.	On the Temperature of the Solar Radiation as Measured by the Black Bulb Thermometer, by Mr. Ellery	23—26
II.	On Moral Responsibility, by Mr. H. K. Rusden	27—46
III.	On an Improved Pair of Scissors for the Excision of Snake Bite, by Professor Halford ..	47
IV.	On the Application of the Cold resulting from the Expansion of Compressed Air, to the Preservation of Animal Food, communicated by Mr. J. D. Postle	47—52
V.	On the Formation of Gold Nuggets in the Auriferous Drift, by Mr. J. C. Newbery	52—60
VI.	Notes on Aneroid Barometers, and on a Method of obtaining their Errors, by Mr. Ellery.. ..	60—62
VII.	On an Improved Method of rendering Casks Air Tight, by Mr. A. K. Smith	62—66
VIII.	On a Method of keeping Accurate Time in the City, Suburbs, and on the Railways, by Mr. Ellery	66—71
IX.	Speculations of the Zodiacal Light, by Mr. T. E. Rawlinson	72
X.	On Colonial Gems, by the Rev. Dr. Bleasdale	72—75
XI.	Description of a Clock made for the Lobby of the General Post Office, by Mr. Ellery	75—76
XII.	On the Teeth and Fossil Eye of the Icthyosaurus Australis (M'Coy) &c., by Professor M'Coy ..	77—78
XIII.	On the Ornamental Stones of the Colony, by Mr. Newbery	79—85
XIV.	Notes on the Various Theories as to the Origin of Species, by Mr. T. Harrison	85
XV.	Further Observations on Snake Poisoning, by Professor Halford	85—87

		Pages.
XVI.	Facts from the Arcana of Science, &c., communicated by Mr. J. W. Beilby	88—108
XVII.	On a Deformed Skeleton, by Professor Halford	108—111
XVIII.	Further Observations on the Temperature of the Solar Radiation as measured by the Black Bulb Thermometer, by Mr. Ellery	112—115
XIX.	On the Supposed Earthquake Wave, by Mr. Ellery	116—117
XX.	Notes on the Secondary Beds of North Australia, by Mr. H. A. Thompson	117—125
XXI.	Description of some New Genera and Species of Australian Polyzoa, by Mr. MacGillivray, A.M., M.R.C.S.	126—148
XXII.	Sketch of a New Theory of the Oceanic Tides, based upon Examination of the causes assigned to exceptional Tidal Waves, communicated by Mr. J. W. Beilby	148

Proceedings i
Catalogue of Books xxxiv
List of Societies xlvi
List of Members l

ART. XII.—*On the Fossil Eye and Teeth of the Ichthyosaurus Australis, (M'Coy), from the Cretaceous formations of the source of the Flinder's River; and on the Palate of the Diprotodon, from the Tertiary Limestone of Limeburner's Point, near Geelong.* By Professor M'COY.

[Read 30th July, 1868]

Mr. Carson, of Collins-street, has recently presented to the National Museum several important additional fragments of the first discovered Enaliosaurian fossil reptile of continental Australia, to which I gave on a former occasion the name *Ichthyosaurus Australis*; and these, with the previous donations of Messrs. Sutherland and Carson, enable me to bring before the Royal Society this evening some interesting additions to our knowledge of the most interesting fossil animal yet found in this country.

In the two portions of the head now on the table, the two remarkably characteristic bones of *Ichthyosaurus*, the *supersquamosal* and the *postorbital*, not present in crocodiles, are visible; and what is probably of more popular interest, the enormous eyes with their bony sclerotic coats are finely preserved. The eyes in this species measure (5½) five and-a-half inches in antero-posterior diameter, and the pupillary opening is little less than (2) two inches. It is not possible to be certain of the number of pieces into which the sclerotic is divided, but it is apparently about (13) thirteen, (there are seventeen in the European *I. communis.*)

Some of the bones now exhibited prove this species to have been one of the largest of the genus, one individual being from analogy, (25) twenty-five feet in length. The series of dorsal vertebræ exhibited with double articulations for the head and tubercle of the ribs on each side, are nearly (4) four inches in diameter, and the elastic capsule intervening between the doubly concave articular faces are well preserved.

The next portion of this curious fossil not previously known is one of the paddles. It has (8) eight rows of phalangeal bones, and as one edge is imperfect, it may have

had more; it is thus one of the most powerful swimmers of the genus, the species found in European rock having paddles with the phalangeal rows varying from (3) three to nine. The *humerus* is (5) five inches long, and the width of the distal end is of the two separate articulations, (2) two and ($2\frac{1}{4}$) two and a quarter inches respectively; the *radius* and *ulna* which follow, are each ($1\frac{1}{2}$) one and a half inches long, and (2) two and ($2\frac{1}{8}$) two and one eighth wide.

The teeth as seen in the last specimen presented by Mr. Carson, have a rough bony square base, like those of the *I. Campylodon*, (Carter), from the Lower Chalk of Cambridge, above which the smooth base of the crown has a circular section; the rest of the conical crown being longitudinally marked with close irregular, obtuse ridges, with much narrower intermediate impressed lines.

(Professor M'Coy demonstrated the anatomical characters of the specimens in full, and explained their affinities.)

Diprotodon.

The next colossal fossil animal of the country, a previously unknown portion I can bring before you this evening, is the palate and two rows of upper molars of the *Diprotodon*, lately found in the fresh-water Tertiary Limestone of Limeburners' Point, near Geelong. This specimen has been presented to the National Museum by Mr. Mercer, through the kind offices of Dr. Day of Geelong. The length of the palate is ($7\frac{1}{4}$) seven and-a-quarter inches, and the width between the premolars is ($3\frac{1}{8}$) three and one eighth inches, and the width between the hind molars is ($3\frac{1}{2}$) three and a half inches. All the proportions of the molars are so nearly like those of the series of molars of the lower jaw of the *Diprotodon longiceps*, (M'Coy), which I described at a former meeting of the Society, that the present specimen may I think be referred to the same species, and I now lay on the table the plates representing that species for the forthcoming Decades, I am preparing for publication, of the Natural History and Palæontology of Victoria. An extraordinary character of this specimen is the persistence of the premolars, which form a fifth molar on each side.

Art. XIII.—*On the Ornamental Stones of the Colony.* By Mr. J. C. Newbery.

[Read 30th July, 1868.]

The colony is indebted to the Rev. Dr. Bleasdale, for his valuable papers read from time to time on the occurrence of precious stones in the colony—real gem stones, and we all know with what splendid success his researches in this direction have been rewarded. The object of this paper is to draw attention to a larger class of stones of less value, yet well adapted in many cases for jewellers' purposes; pedestals, for statuettes; small vases; inlaying as in table-tops; and building and architectural purposes. There are no doubt many omissions from the list which is given, but this paper must be looked on as little more than an introduction to the subject.

The first stone, or rather species, that claims our attention is quartz, with its chalcedonic varieties, which will include rock crystal, cairngorm, amethyst, smoky quartz; and, amongst the true chalcedonic varieties, agate, common chalcedony, cornelian, onyx, jasper, &c.

The principal locality of occurrence for the first four kinds of quartz is the Beechworth district. Pebbles of considerable size and great beauty, as regards colour and transparency, occur there in auriferous drifts of numerous gullies and creeks. Amethysts of sufficient size or value for cutting are far rarer than the three other kinds; although, as specimens for mineral collections or as small ornaments, such as the heads of breast-pins, &c., the pretty, perfect crystals, double hexagonal pyramids with prism, occurring in the drift and in the narrow veins traversing the granite rock bottom at Eldorado and Sebastopol deserve mention. The other localities where these varieties of stones are found are the Upper Yarra goldfields, Bendigo, White Hills, Bradford Lead (Maldon), and a few other places. There is scarcely a doubt that the Bradford Lead, Maldon, is worthy of attention, and that a search in the heaps of pebble drift taken from hundreds of shafts sunk along the extent of the lead would be well rewarded. For the chalcedonic varieties Beechworth is also the principal place of occurrence, as was well exemplified by the fine collection of onyxes, cornelians, and agates of diversified and beautiful patterns shown at the late Intercolonial Exhibition. Common chalcedony in

irregular pieces is found in veins in the decomposed older basaltic rocks of Phillip Island, and can be collected in great abundance along the sea-beach at the foot of the basalt escarpment. Most of the pieces have a neat pattern formed by alternating concentric white and bluish-white bands; several centres often occurring on one stone. Many have fissures or cracks in them; the sides of which are often coated with quartz crystals; in others, these fissures are filled with carbonate of lime. Remembering the successful practice carried on for many years by the lapidaries of Oberstein and Idar, in Germany, of artificially colouring common chalcedony, producing, by chemical means, bands and spots of different colour throughout the stone; making them thus look like chrysoprose, agate, onyx, sardonyx, &c., a few preliminary experiments have been made in the laboratory with pieces of chalcedony from Phillip Island, with a view to producing artificial onyx, and the results have been so far successful as to permit the hope that if the process was properly executed according to the now known process, good artificial onyx's could be produced.

This art of colouring stones was according to Pliny known to the Romans. He says in the 75th chapter of the 37th book, that certain gemmæ of agate (cochlides) might not be natural, but artificially made. He further narrates that glebæ (nodules of agate) were found in Arabia; which, if boiled in honey for seven days and nights for the purpose of cleansing them from impure and earthy matters, could then be prepared by artists in such a manner that they received coloured bands and spots.

This secret seems to have been lost for a long time; but during the last century the Roman lapidaries were known to possess it. They collected the chalcedony from the German miners, sending travellers for the purchase, who, by some secret process detected the stones fitted for the purpose.

This manner of trading attracted attention, and the secret was bought from an Italian traveller by a miner who first secretly practised it by himself, but it since became generally known, and is indeed very simple. Specimens of chalcedony which contain amongst the concentric or parallel veins some that are softer, and therefore, more permeable by fluids, are chosen; and this property can be tolerably well detected by mounting the stone and noticing whether any absorption takes place. The stones which shew the greatest irregularity in this respect are the best fitted for the purpose. The

process then consists of washing the stones carefully, and allowing them to dry at the temperature of the air, and then placing them in a solution of honey diluted with water, in the proportion of half-a-pound of honey mixed with a quart of water. The stones are kept in this solution at a temperature somewhat below boiling heat, for from fourteen to twenty days; water being added from time to time to supply that lost by evaporation. After this the stones are removed, carefully washed, and then placed in common sulphuric acid, which carbonizes the honey that has been absorbed into the pores of the stone, leaving black lines and bands. Using other solutions, of course other colours would be obtained. Nickel and chrome would produce green chrysoprose. It is necessary to notice the discovery of chalcedony in the Dandenong district, whence several specimens of a very well-handed variety have been brought by Mr. Hardy. They occur there with dark brown opaline flints, and are probably derived from the older basaltic formations which occur in the neighbourhood, and have been subjected to denudation.

Another locality where agates and jaspers have been found in abundance is on the Cape Otway coast, near the mouth of the Gellibrand river. Mr. Wilkinson, in exploring this portion of the country some years ago, found that the coast was covered with a bed of shingle, composed of pebbles of jasper, dense quartz rock, and various very fine kinds of porphyry. Rock masses similar to these latter are not known in the colony; therefore, it is supposed that they are derived from a conglomerate composed of these pebbles, which must form the bottom of Bass' Straits at this point, and stands, perhaps, in some near relation to our upper palæzoic conglomerates that appear as small outlines over the central portion of the colony.

As nearest allied to the stones forming varieties of quartz, it is right to throw a passing glance at the class of common opal, opal-jasper, semi-opal, and wood-opal, which occur in many places in the colony. Though not of any very great beauty, they are in Europe frequently fashioned into neat ornaments; those of wood-opal especially forming objects of considerable interest. The common opal, semi-opal, and opal-jasper are usually of a blue-brown or yellowish-green colour; they are found in the basaltic clays near Melbourne, Keilor, Bacchus Marsh, and Sunbury.

Wood-opal, of various shades of brown, in which the

grains of the wood is easily detected by the differences in colour, occur at the Bass River, Western Port, in the Grampians, and in the leads at Daylesford and Ballarat. With reference to colour, there is one, green, which is very poorly represented in Victoria, both in gem and ornamental stones. We have neither the emerald or chrysolite (olivine, a variety of the latter occurs abundantly in the basalt, but is of no value for the lapidary), and the malachite found at the Thomson's River Copper Mine is not large enough for cutting.

At present green stones seem very fashionable, and small ornaments of nephrite from New Zealand (many by no means of a pretty colour) are much in demand. It may be of some use to call attention to a green colonial stone, that has been named Selwynite, after Mr. Selwyn, of which a short description may be found in the essay published by the Geological Department for the late colonial exhibition. It occurs in the upper Silurian rocks on the flank of the Mount Ida range, about four and a-half miles north-west of Heathcote, whether as a dyke or an irregular mass the explorations do not permit at present to be determined, though it is very probably connected with one of the many greenstone dykes traversing that district. As far as can be made out, the stone which was first observed, some years ago, was mistaken for copper ore, and a shaft of seventy feet was sunk in the mineral. From the heaps of stuff round the shaft Mr. Taylor, of the Geological Survey, who surveyed the country, obtained the specimens exhibited. The colour, as will be seen, varies from that of a siskin to dark emerald green; its hardness is about that of malachite, and it takes a very fair polish. It has, unfortunately, a tendency to crack, and is very brittle. This tendency may be, to a great extent, caused by exposure to atmospheric influences, and the freshly dug stone may be found without this tendency, and the great difficulty of cutting be obviated. As to the brittleness of this stone, Mr. Schaefer, the jeweller who made the pin exhibited, states that by boiling it in oil, and other treatment known to jewellers, it may, perhaps, be overcome even in the specimens which have been exposed. The analysis shows the per centage composition of the mineral to be silica, 47.15; chromium, 7.61; aluminia, 33.23; magnesia, 4.56; water, 6.23. It cannot be identified with any mineral described in the mineralogies, and is, therefore, quite new, and from its mode of occurrence, and its composition, it may

be considered as a new rock as well as a new mineral species. Its colour is given by the sesquioxide of chromium, which is probably derived from the chrome iron ore, a mineral abundant in the neighbourhood of Heathcote.

Gabo Island Granite.

This rock probably occurs as a dyke. Its mineral properties place it into the class of syentic granites. On the mainland it becomes more and more like a true granite in its composition.

The stone is so well known in Melbourne that it needs but a passing notice. It being used at the base of the Post Office, where it may be seen in a trimmed and untrimmed state, and at the Australasian Insurance offices, where there are some beautifully-polished pillars of it. It is very hard and tough, so much so as to prevent it coming into general use for building purposes; but its toughness renders it extremely useful for ornamental building purposes exposed to the weather or wear. A similar stone occurs at the head of Nuggetty Gully, Daisy Hill.

Geelong Greenstone.

Attention was first called to this stone many years ago by Mr. Daintree. In a report of his published in 1863, he says, "To the greenstone of the Geol. ¼ s. 24 S.E., I wish to call the attention of sculptors and workers in ornamental stones. Since, though hard to work it takes a beautiful polish, and the play of colours is little inferior to verd-antique." Though this notice was published five years ago only a few cabinet specimens have been cut and polished. Some of these taken to England and the Continent were much admired. Its toughness and closeness of texture would permit of its being used for many articles of jewellery. The fine play of colours is due to the Labradonte felspar, which constitutes a large per centage of the general green colour of the rock and is due to angill with some chlorite.

Lancefield Greenstone.

This large dyke-like mass of diorite (¼-sheets 5 S.E., and 5 N.E.; the latter unpublished), forming a high spur, with a meridional direction, from the Great Dividing Range, is very variable in its lithological character. Mount William, at the extreme northern and highest part of the range, and at its junction with the Great Dividing or Coast Range, is com-

posed of a very hard dark greenish-black dense rock, closely approaching a basalt, and with a metallic ring where struck, like clinkstone; passing southwards to a lighter green, hard rock with albite crystals, sometimes having the appearance of a greenish-white rock with black dendritic markings. This stone, were it not for its extreme hardness and consequent difficulty and expense in quarrying and working up, would make a very handsome stone for building or ornamental purposes. Further south it becomes a black, highly crystalline rock, and then again a dark green dense rock with specks of iron pyrites. About a mile north-east of Mount William, and in a saddle between it and the Black Range, is the site (locally called "The Native Tomahawk Quarries") whence the aboriginal tribes of the neighbouring districts have procured the greenstone used by them for making tomahawks. From the amount of broken and chipped stone covering a large area, this quarry must have been in use for a very lengthened period. The stone takes a very sharp edge. A large boulder stands up in the centre of an open pit, chipped all over superficially, and apparently in great requisition from its extreme hardness; but which has resisted all their efforts to raise it from its bed.

Benallic Shell Limestone.

This limestone is found in the valley of the Moorabool and at Barwon Heads. It resembles very closely the white limestone from Omaru, New Zealand, and might be used for the same purposes. It is especially adapted for light, ornamental mouldings, as it may be readily carved into figures with an ordinary knife. Specimens freshly removed from the quarry harden on exposure to the air, and are less readily worked, but it of course makes the stone more durable. Considerable care would be required in selecting the stone; for, in places it varies both in colour and texture, the colour becoming a pale brownish-yellow, and the texture more open when the fossils of which it is composed attain a large size. As a building material, it should be of considerable value in the country; but in large towns, where the atmosphere is always more or less charged with smoke and acid vapours, unless protected, it would be liable to blacken and decay. This could be prevented by silicating the stone by immersion in a solution of a soluble silicate, and then in one of chloride of lime, or washing the surface with these solutions after the erection of the building. This process,

which is readily and cheaply performed, would render the most delicate carvings in this stone impervious to smoke, and quite, if not more durable, than ordinary sandstone, and at much less cost.

The only uses to which this stone is applied are, the moderately porous portions for water-filters, and the friable parts for mixing with night-soil to be used as manure.

A sample which has been exposed to the acid vapours of the laboratory has in a year suffered but little.

ART. XIV.—*Notes relative to the respective theories, Creation by Law, and Creation by Fact.* By MR. THOMAS HARRISON.

[Read 10th August, 1868.]

Mr. Harrison in this paper sought to reconcile the various theories, (both religious and scientific) propounded as to the origin of man. Without absolutely agreeing with the doctrines of Lamerk, the Vestiges and Darwin, Mr. Harrison engrafts their views upon certain ideas of his own, best defined in the following sentence quoted from his paper, which trenches too much upon theological subjects to be printed in the Transactions.

"So far from shutting God out of his own creation, as the "pure development theory seems to do, the present view "represents him as continually superintending it."

ART. XV.—*Further Observations on Snake-Poisoning.* By GEORGE B. HALFORD, M.D., Professor of Anatomy, Physiology, and Pathology in the University of Melbourne.

[Read 27th August, 1868.]

In former papers communicated to this Society I have dwelt particularly on the vast numbers of white cells seen in the blood after death from snake-poison. Subsequent and repeated observation have confirmed my original description equally of the growth, size, and maculated condition under the influence of magenta of these bodies; but lately my friend Mr. Ralph, surgeon of Kew, near Melbourne, has discovered a nearly similar condition of blood in animals poisoned by prussic acid. I have confirmed his observations, and most probably such bodies will be found and arise wherever after death coagulation of the blood does not take

place. The whole subject, therefore, requires reconsideration. The facts are as I stated, but possibly have relations hitherto unknown to me.

From the first I stated these white cells arise in a structureless molecular matter, nucleus first, cell-wall after; and that in some manner they took the place of what is called fibrine, and, further, that the higher the thermometer for the time being the more numerous and larger were these bodies.

The changes, therefore, take place when the blood is stagnant, but still retained within the veins.

Now it is fortunate that I can direct the attention of this Society to some other phenomena in the growth of cells as observed by Dr. Onimus and recorded in the "Journal de l'Anatomie et de la Physiologie," 1867, and just received in Melbourne. He disbelieves in the doctrine of Virchow that *omnis cellula ê cellulâ,* and holds that *cells arise in an amorphous blastema.*

This agreeing with the origin of the white cells I have described, let us follow Dr. Onimus in his experiments and conclusions.

The fluid from a recent blister was filtered so as to obtain a fluid containing no kind of form, neither white corpuscles nor epithelial scales. This fluid was enclosed in small tubes of gold-beaters' skin, and placed beneath the skin of a live rabbit.

After two hours—the serum was still transparent, although it had lost its primitive citrine colour. In it were seen a few white cells and granules.

After 24 hours—the serum was turbid, and contained a great quantity of white cells and granules.

After 36 hours—the serum was quite white, milky, and composed entirely of white cells and granules. The white cells having all the characteristics of white corpuscles of the blood.

Increase of animal temperature aided the production of the white cells.

No white cells, nor any sort of anatomical element was formed in the serum of blisters, from which the fibrine had coagulated.

The presence of white cells artificially added to serum from which the fibrine had separated, had no effect in causing further development of white cells.

It is certain, therefore, there is some relation between the growth of white cells and those elements which by their separation from the liquor sanguinis constitute fibrine.

It will be remembered that I referred all the morbific agency to the microscopic germinal matter found in snake-venom, and not to any fully formed cells. Dr. Onimus observes that in infectious diseases, miasmatic or virulent, changes are not found on the side of elements having form, but in the composition and properties of the plasma. The white cells of the virulent pus of a chancre resemble those from a healthy sore ; it is in the serum that search must be made for the difference in the properties of the two purulent fluids.

It is, however, possible, that with increased microscopic power, and more time for such labours, modifications of form and property may even be recognised in the molecular matter of serum.

Now, it has been maintained by some, and by Dr. Weir Mitchell, of Philadelphia, whose writings on snake poisoning deserve, and have my willing respect, that nothing like germinal matter exists in snake venom. I cannot agree with him.

But I have always stated it exists in a very microscopic form, and that to this minute elementary germinal matter the activity of the venom is due. Since this was stated by me, similar conclusions have been arrived at by M. Chauveau (Comtesrendus, 1868), of the nature of the vaccine virus, which he describes as consisting of—first, the serum, an albuminous fluid, holding the various soluble substances in solution ; and, secondly, the solid elements, consisting of white cells and of elementary granules, both of which are suspended in the serum.

After separating the white cells, the remainder was as virulent as ever, and the clear serum was found to be harmless ; but in the elementary granular matter dwelt the activity of the virus.

For the present I must leave the further consideration of this difficult yet interesting subject. During the coming summer I will devote my spare time by some attempts to arrest the changes which take place in the plasma of the blood in severe cases of snake-poisoning. In the meantime I hope this short and imperfect communication may induce others to think on the correlation of the animal poisons.

ART. XVI.—*Facts from the Arcana of Nature apparently at variance with the accepted Theories of Science.* By Mr. J. WOOD BEILBY.

[Read by the President, 14th September, 1868.]

Astronomy regards the figure of the Earth as that of a sphere, somewhat flattened towards the poles, and bulged out equatorially. This definition of its form is educed from the assumption that its primitive state was that of a molten mass of matter, rotating in space, with such velocity as necessarily to cause it to assume an oblate spheroidal form. Upon this fundamental hypothesis are based therefore all astronomical calculations, defining the position, upon the exterior of the globe, of the points of the polar axis, the division of the globe into hemispheres by the terrestrial equator, and the position of the parallels of latitude and longitude. In the practical use of such calculations applied to geodetic measurements, and defining positions at sea, of vast importance to the safety of our shipping, results, questionable to the accuracy of scientific for mulas prescribed for the conduct of these calculations, as applied to local observations, are constantly occurring, and too often with disastrous consequences to human life and property. An analysis of the question cannot therefore be deemed unimportant, more especially if carried out without bias in favour of theories adopted by early philosophers, whose means of comparing observations of the phenomena of Nature were but few compared with ours.

The late Astronomer Royal, Dr. Maskelyne, remarked that "Probably no branch of science is more subject to erroneous conclusions than that of hydrology." The questionable accuracy of existing modes of conducting astro nomical observations to determine the Figure of the Earth, may be deduced from the facts undernoted.

1. Arago observes, "That the several degrees measured on each meridian, between the pole and the equator, combined two and two, do not all give the same value for the flattening at the poles." It is also observed, that the alteration in the length of the degrees is very irregular, and as yet unaccountably so.

2. The refraction of light by the atmosphere is very great when the visual angle is nearly horizontal, and hence arises great errors in the measurement of angles, whether the

observed objects are in the same level or not. These errors are usually remedied by an empirical law for terrestrial refraction; but all such laws fail to apply in the varied states of rarefaction or of moisture, in which the lower strata of the atmosphere are found.

3. An error of a single second in the celestial arc corresponds to about one hundred feet on the surface of the Earth; and a long series of astronomical observations must be made to obtain the latitude of any place true to a second.

4. Local attraction of mountains, and variations in the density of strata in the Earth are said to affect the accuracy of the pendulum.

5. It has been demonstrated that the figures of the northern and southern hemispheres are dissimilar.

6. No measurements have yet been attempted within such distance of the poles as to preclude the possibility of an extended polar radius, in excess of the supposed equatorial radius.

7. Some of the earlier observations made by the French astronomers, gave results directly contrary to Newton's theory.

8. Unaccountable discrepancies have been noted in results of previous admeasurements of degrees on reversing the course of the ship from which the observations have been taken.

9. Analysis of the theory of rate of transmission of light may affect the time of high noon recorded, to a degree imperfectly provided for by previous empirical conclusions.

Noting how rare it is—if not in practice impossible—in land surveys by successive operators, though using approved instruments, to maintain lengthened parallels, the accuracy of sea measurements must ever be doubtful. Moreover, Sir John Herschel admits that "a more exact knowledge of the physical structure and figure of the Earth, and of the niceties of astronomy, may render a different mode of computing latitudes necessary." Thus, this eminently scientific astronomer does not bar entrance on the path of knowledge by asserting perfection of existing theories, or the infallibility of the conclusions of our early and justly renowned philosophers.

Our task shall be to demonstrate that there exists, to say the least, a difference of opinion amongst astronomers, mathematicians, geologists, and philosophic reasoners, as to the accuracy of our early philosophic theories respecting the figure and structure of the Earth, and its im-

perative continuance upon a permanent axis of rotation. We shall, however, disclose an agency in continuous operation in Nature, productive of elongation of the polar radii, but so unequally developed, though strictly in accordance with natural laws, as presently to increase the arctic elongation disproportionately, so as continuously to shift the centre of gravity of the Earth's volume, and thus alter its axis of rotation, and consequently the position of the polar extremities upon the sphere, and cause an apparent change of its position upon the plane of its orbit.

The defined position of the magnetic poles presents an anomaly with reference to the stated figure of the Earth, they being "not diametrically opposite, nor is the variance so slight as it necessarily would be if the figure of the globe were spherical, or equally depressed at the poles. While the north magnetic pole is defined by observation of Admiral Ross in lat. 70° 5′ 17″ N., long. 96° 46′ 45″ W., the south is stated as in lat. 70° S., long. 154° E. They are thus neither diametrically opposite to each other, nor either of them coincident with the geometrical pole of the magnetic equator." Again, the division of the globe into two hemispheres by a supposed central line, termed the terrestrial equator, and the geographical definitions of latitude, have been computed—subject to the Newtonian theory of the oblate polar extremities affecting the necessary observations in an admitted degree, as also disturbing agencies, arising from solar, lunar, or planetary attraction upon the alleged bulge or redundance of matter (said to amount to thirteen miles in thickness at the equator) —in excess of oceanic or other dilatation on other parts of the earth's contour. Pendulum experiments are even stated as agreeing in giving a greater ellipticity to the earth than that which is deduced from the comparison of arcs of meridian, amounting to 1-306th. Upon the principle of necessity of maintaining current hypotheses upon the relative densities of the various proportions of fluid and solid matter, composing the superficial rind of the sphere, and the notion of a flattening at the poles, this aberration has been ascribed to inequalities in the motion of the moon.

It has been announced as a recent astronomical discovery, that the distance from the sun to the earth, formerly stated at 95,000,000 of miles, is actually less that quantity by 3,000,000. In other words, calculations involving the sun's meridian altitude, allowing for transmission of his light to our globe at the rate of 192,000 miles per second,

have heretofore over-estimated this element of dubiety by about sixteen seconds.

It is stated, that "In middle latitudes of the northern hemisphere, when the sun is eastward of the meridian during the forenoon, the needle points more eastward than on the average of the twenty-four hours; also, when west, during the afternoon, it points more to the westward." "The angle of the dip, like that of the variation, changes its value even at the same place, following of course the motion of the magnetic poles, which from observations made by Scoresby, Parry, Ross, and others in high latitudes, appear to have a motion westwards, the annual amount of which is 11′ 4″." It has, however, been conjectured that there are two distinct poles of magnetic attraction in arctic regions, one defined as the American, the other the Asiatic, presently many hundred miles apart, but apparently approximating towards perhaps ultimate coincidence. "The diminution of the magnetic dip noted in London for the last half century, is progressing with great regularity at a definite small annual rate." All such phenomena indicate the ceaseless operation of natural laws as yet unrecognised or imperfectly understood by science, but which may mark physical changes of vast and startling import to mankind.

Mr. Airy, the Astronomer-Royal, in his Report to the Board of Visitors for 1861, observes, "The Transit Circle and Collimators still present those appearances of agreement between themselves, and of change with respect to the stars, which seem explicable only on one of two suppositions, that the ground itself shifts with respect to the general Earth, or that the *axis of rotation changes its position.*" Again, in 1863, he remarks, that "Some great cosmical change seems to have come upon the Earth, particularly affecting terrestrial magnetism."

The greatest vertical depth to which experiment by boring has tested internal heat is as yet stated to be but 2,100 feet, or about one ten thousandth part of the earth's radius, a limit far too fractional to admit of positive conclusions being formed thereon, as to the increasing internal heat of our globe towards its centre. Admitting, however, that progressive elevation of temperature is detected in certain localities, to that depth, the results of numerous experiments, undertaken to test the temperature of the ocean in various parts of the world, at vastly greater depths, are conclusively adverse to the doctrine of the internal heat increasing in proportion to

the depth attained from the surface. It is now an ascertained fact, that the deep sea is of one invariable temperature, and that a very low one. The calculations of Lenz, based upon Kotzebue's and Beechy's observations, give 36°, and those of Ross 39°·5 Fahr. The depth at which this temperature is attained is 7,200 feet at the equator, diminishing to 56° 26′ S. lat., where it attains the surface, and the sea is of equal temperature at all depths. How can we reconcile such facts with the theory of central incandescence of the matter of our globe, or explain them so as to leave a fraction of evidence, in favour of a supposition of the primitive molten fluidity, and present central combustion of the earth? Yet upon such a gratuitous supposition is the alleged figure of an oblate spheroid educed, as necessarily that of our globe, formerly described as flattened at the poles like an orange, but now regarded by astronomy as so slightly varying from perfect sphericity, as to require in an ordinary model, the nicest calculations or geometrical observation to define the existing difference. The Earth's velocity of rotation upon its axis, aided by the natural law of gravitation of its watery envelope to the centre of gravity, are adequate to account for an almost perfect sphericity of its external aspect, but we have no proof available either of its internal structure and the relative density of its proportions throughout, or of the form of its solid exterior, if divested of its oceanic covering. It may be as "without form," as the unshapely meteorites in our museums, and partially or wholly "void" of solid matter internally. How is oxygen supplied to maintain combustion in its central furnace? And how came water to remain over the vent-holes in the crust of its molten mass?

Astronomy declares that "the change, which, owing to precession and nutation, is constantly taking place in the position of the terrestrial axis of rotation, is only in respect of fixed points in space; for it can be shown that since the earliest recorded astronomical observations, the position of the poles of rotation on the Earth's surface has undergone no alteration whatever." Yet it appears that "in consequence of the precession of the equinoxes, the sun's place among the zodiacal constellations, at any given season of the year, is now greatly different from what it was in remote ages. Sometime before the age of Hipparchus, the first points of Aries and Libra corresponded to the vernal equinoxes, and those of Cancer and Capricorn to the summer and winter solstices. These points have now receded 30° from the constellations to

which they then corresponded. The vernal equinox now happens when the sun is in Pisces ; the summer solstice when he is in Gemini ; the autumnal equinox when he is in Virgo ; and the winter solstice when he is in Sagittarius. Astronomers, however, still employ the term, the first point of Aries, to denote the position of the vernal equinox."

This change in the apparent position of stars is astronomically termed, the uniform increase of longitude, by Sir John Herschel, "That is, the apparent approach of some stars and constellations to the pole or vanishing point of the Earth's axis, and recession of others." Thus, by the fiction of regarding the sun and stars as movable, with reference to stated points on our sphere, instead of such motion being confined to the Earth itself, and thus made apparent to man—as passengers in a coach see distant objects apparently passing their limits of observation—have astronomers been led to overlook the palpable proofs available of the continuous deviation terrestrially, of the poles of the Earth's axis of rotation, and consequently, to build up a series of fallacious theories to account for movements, referred to a revolution of the celestial sphere, which are simply terrestrial, apparently ever progressing since the beginning of our globe's history, and the inevitable and natural result of the operation of natural laws.

M. Adhémar (a French mathematician of eminence), author of *Révolutions de la Mer, Déluges periodiques, Paris,* 1843, accounts for the position assumed by the Earth upon the plane of her orbit, as being the result of the accumulation of ice alternately at either pole, depending upon the declension of climate induced by the phenomena of the precession of the equinoxes in either hemisphere alternately, during successive epochs of the period assigned by astronomy to a revolution of the ecliptic, or 25,868 years. According to his theory, the Earth is now progressing towards a secular change of her position upon the plane of her orbit, to be accomplished, with all its contemporaneous phenomena of aqueous and igneous convulsions, as soon as the period of 12,934 years—less the time, some 4,200 years, now elapsed since the deluge of Noah —completes one half of such revolution of the ecliptic. Adhémar's theory, however, though suggestive of a cause, by accumulation of polar ice, of change in the Earth's centre of gravity, is faulty in that he assumes, that the time has not yet arrived for a disproportionate arctic accumulation of ice, and consequent gravitation of the watery envelope of the

globe towards the thus northerly varying centre, tending to depression of sea surface in the southern ocean, and elevation thereof upon shores in the northern hemisphere, which tendencies however are noted by science. The sea surface is ascertained to be rising on the coasts of West Greenland, while depressing on the shores of Australasia, and to have attained, according to Arago, an elevation on the shores of Russian Siberia of several hundred feet above the vast central area of the continent of Asia, and also above the coasts of Europe, from which the waters are receding, thus depressing their surface level.

By the help of eclipses, in which the Earth casts her shadow on the moon, the fact of elongation of the poles by glacial accumulation, as noted in the aspect of the planet Mars, may be ascertained astronomically. Kepler relates that the eclipse of the moon of the 26th September, 1624, which was total and central, surprised him greatly, "for not only," he states, "was the duration of total darkness short, but the remainder of the duration of the eclipse, before and after the total obscurity, was still shorter, as if the Earth were elliptical or lemon-shaped, and had a shorter diameter across the equator, than from pole to pole."

Johannes Von Gumpach, in his astronomical work on the *True Figure of the Earth*, 1862, observes that, "After one hundred and fifty years of unceasing efforts, astronomy has yet to discover whether the terrestrial equator forms an ellipse or a circle; after a century and a half of unsuccessful calculations, analysis is still seen toiling to invent empirical formulas for the purpose of establishing a tolerable accordance between the geodetic measurements of to day, with those of yesterday." He elaborately demonstrates by geometrical computations, and logical hypotheses, upon astronomical and geodetic observations, that the Earth instead of being flattened is elongated at the poles, and attributes to errors of calculations, based on the Newtonian theory, annual losses at sea involving great destruction to life and property.

The first observations recorded of the phenomena of the precession of the equinoxes, are referred to Hipparchus, an early astronomer, who catalogued the stars some 128 years before the Christian era. It is related that Sir Isaac Newton began his investigations respecting the fact of precession with considerable dubiety, stating that, "though not destitute of probability, it might not prove conformable with truth, and involved a mechanical principle taken up without due

consideration." He, however, first submitted a theory of causation, assuming that the primitive molten fluidity of the Earth's volume was an indisputable fact, and hence there had resulted from its velocity of rotation, an equatorial bulge or redundancy of matter, developing a surface subject to unequal attraction by "universal gravitation" of the sun and moon, the result of which is a reeling motion of the Earth's axis, —stated as only with reference to surrounding space, not admitted as within the periphery of the globe itself,—from east to west, and the recession westward of the equinoctial points. In the time of Hipparchus, this recession amounted to 45″ annually, but has since varied, and is now stated at about 50¼″ annually, equal to one whole degree in seventy years. M. D'Alembert, an ingenious mathematician, attained scientific laurels by his geometrical demonstration of the momenta necessarily evoked by the joint attraction of the sun and moon, resulting in the phenomena of precession. Ever since mathematical demonstration of perturbations stated to be effected by "universal gravitation," has been resorted to, to explain away noted discrepancies of observations, which, duly investigated, might have extended the area of human knowledge of facts in physical astronomy ; and displaced a host of questionable hypotheses, in favour of an accumulating code of natural laws, the continuous action of which throughout nature, could be vouched for by incontrovertible data, deduced by careful observation in all departments of physical science. Brewster remarks, "The influence of the imagination as an instrument of research, has we think been much overlooked by those who have ventured to give laws to philosophy. This faculty is of the greatest use in physical inquiries. If we use it as a guide, and confide in its indications, it will infallibly deceive us ; but if we employ it as an auxiliary, it will afford us the most invaluable aid." Recent investigations into natural phenomena induce the belief that Newton's solar gravitation theory may be *over-strained* to account for terrestrial movements ; and that the maximum obliquity of the angle of intersection of the planes of the equator and ecliptic, may have resulted from an unequal development of polar glacial enlargements, effecting perhaps at first a gradual change, but ultimately a sudden alteration of the earth's centre of gravity, when the bulk of the waters enveloping the globe would gravitate into the hemisphere containing the preponderating glacial accumulation, and, by this unequal oceanic distribution, cause the earth to assume her astronomi-

cally noted position upon the plane of her orbit. The records of scientific exploration and discovery demonstrate that the antarctic regions are less accessible to exploration from accumulated ice, than similar latitudes in arctic regions; while the depth of ocean, tested by soundings (of which one recorded by Captain Ringgold, obtained bottom at 8,000 fathoms, with the elevation of ocean level, displacing the denser strata of the atmosphere), noted barometrically, are greatly in excess of their mean rates, recorded by numerous and careful observations in northern latitudes.

From the position of the sun upon the ecliptic, the northern hemisphere enjoys annually some seven-and-three-quarter days longer solar influence than the southern hemisphere, yielding an excess of the temperature productive of evaporation from the sea surface —twenty-four hours of sun in polar regions being estimated to yield as large a vaporizing effect as twelve hours sun in the tropics, while the precipitation is entirely local—and also tending to great increase of snow storms rather than to intense congelation. Accumulation of snow, and its alternate thaw and congelation, so as to fill up intervening hollows in the mountain peaks, progressing throughout thousands of years, must inevitably affect the earth's centre of gravity, by prolongation of the polar radius.

The vast and increasing height of the snowy pinnacles of the Himalayas—in the mild latitude of 30° north, reaching an altitude of 29,000 feet, or over five miles—induces the belief that the accumulations within the regions of continual precipitation and congelation, must attain a proportional and vastly greater height. If a continuous series of changes in the Earth's centre of gravity are indicated by the ever progressing alterations of sea level over the whole Earth's surface, what conclusions force themselves upon us in the effort to account reasonably for these phenomena? Is the idea of the preponderating influence of Arctic glacial enlargements, continuously augmenting in volume and density, so as gradually to equipoise and ultimately overcome the resistance offered by the antarctic ice, and oceanic enlargement to a more nearly diametric centre of gravitation, not more logical than hypotheses of solar or planetary influences, as acting upon an alleged uniform redundancy of matter, or oceanic enlargement, not yet ascertained to exist, within the tropics? That there are elevated surfaces of watery accumulation in the tropics, is admitted by Arago, who states that so true is it that the waters accumulate in the Gulf of Mexico, that it has

been found by effecting a series of levelling operations across the Isthmus of Panama, that they rise fourteen feet higher in the Gulf than in the Pacific Ocean; whence arises such irregularity under the alleged influences of solar gravitation?

Can astronomy demonstrate that the barometric column indicates by deficiency of atmospheric weight or pressure, that within the tropics there is such a redundancy of watery accumulation, exceptional to the general contour of the earth's surface as, presuming the theory of solar attractions to be irrefutable, may reasonably be held to present an enlarged surface, likely to offer greater attraction to solar influences, than other or more elevated oceanic regions? Maury states that the deficiency of atmospheric pressure at the equator, is represented on the height of the mercurial column by .24 of an inch. This is equivalent to a height of only about 220 feet over the mean level of the sea in the temperate zones. Sir J. C. Ross states the mean barometric pressure at the equator as 29.974, while in latitude 74° south, it was only 28.928, or fully an inch less, or equivalent to an elevation of sea surface, over mean sea level throughout the earth of 800 to 1000 feet. Analysed thus, the alleged equatorial protuberance of water is much less than in high latitudes of the southern hemisphere, and lessening, by a gradual variation, from latitude 22.°17′ south. Again, at Melville Island, in latitude 74¾° north, it was found to be 29.870, implying an almost equal redundancy of oceanic accumulation to that barometrically ascertained to exist at the equator. Erman, a traveller in Asiatic Siberia, observed a deficiency of pressure on the barometric column, to the extent of an inch and upwards, in the vicinity of Yakutsk, and on the sea of Okotsk; which appears to indicate elevation of sea surface above that at the equator, within the area assumed by the Newtonian theory of the figure of the Earth, to present a depressed or flattened surface.

The deficiency of atmospheric pressure, alike at the equator and in high latitudes, has been referred to an excess of ethereal vapour in the atmosphere, causing its ascent. However applicable to deficiency of pressure at the equator, the reason assigned cannot hold equally good in icy regions. Our barometric readings are at their highest during continuance of calm frosty weather. Moreover, air-borne vapour cannot retain its ethereal condition when exposed to a temperature causing its congelation and descent as snow; while there is

no reason to assume that the higher atmospheric strata in Arctic regions, remain permanently warm enough to retain in suspension accumulated vapours, so as to invariably affect the barometric column as noted by Antarctic explorers, during their "many thousand observations." Arago presumes the existence of atmospheric tides as the result of solar attraction, but these not being indicated barometrically, he suggests that "columns of air, though of different heights, must everywhere be of the same weight, the height compensating for the diminution of weight." The particles of air being rendered lighter by vesicles of vapour adhering to them and expanding them hollowly, certainly ascend, but although thus lightened in the denser strata near the Earth's surface, the increased height of the column must cause an equilibrium of weight as before. But if elevation of the ocean level displaces the densest portion of the atmosphere, deficiency of weight will manifest itself by diminution of pressure.

Observations in nature demonstrate that the waters enveloping the globe, are steadily retreating from certain shores, and gaining upon others; and this on the grand scale of our whole world, without reference to local changes, the possible result of igneous agencies; or of sea waves, in silting up, or denudation. At same time, astronomical observation discloses the fact of the continuous approximation of the plane of the heretofore supposed permanent equatorial intersection of the globe, to the plane of the Earth's orbit of revolution. Are we not therefore justified in the belief that a natural process is at work slowly increasing the density of the matter of the northern hemisphere, and thus its tendency towards a position of coincidence of the planes of the equator and ecliptic; evincing an alteration—progressing uninterruptedly in one direction—in the Earth's centre of gravity. This, however small, and imperceptible in annually recurring quantity, must inevitably effect, as well as mark, a change in the axis of rotation, and consequently, in the position of the polar extremities upon the sphere, giving rise to alteration of the relative positions of the zones of temperature; so that, while one area is being absorbed within the Arctic circle, another within the same latitude, as presently defined, is progressing at the same rate of motion, towards the temperate zone.

It is obvious that the movable matter or oceanic envelope of the globe, must, in obeying the natural law of gravitation, converge towards the centre of gravity of the whole volume

of the Earth. The consequence of a continuous change in this centre, in one direction, must be the progressive increase of depth of the seas, in what,—if we still hold that the poles and equator are unchangeable in position, upon the Earth's surface,—we can only describe as the thus enlarging hemisphere. As the depth of water increases, the coast lines appear to be depressed, and vice versa, with regard to coasts from which the waters are receding. Sir J. C. Ross observes that Baron Von Humboldt suggested the fixing of solid, and well secured marks, for the purpose of showing the mean level of the ocean at a given epoch, stating that, "if similar measures had been taken during Cook and Bouganville's earliest voyages, we should now be in possession of the necessary data for determining whether secular variations in the relative level of land and sea, is a general or merely a local phenomenon, and whether any law is discoverable in the direction of the points which rise or sink simultaneously."

Observations in meteorology demonstrate that a large portion of the vapour abstracted by solar heat from the sea surface, throughout the globe, and lands moistened by tropical rains, or other causes, ascends to the higher regions of the atmosphere, and is conveyed by perpetually flowing air currents, towards the poles. Upon contact with air of Arctic temperature, whether on the lofty peaks of the Himalayas and Andes, in temperate zones, or within the margin of the frigid zones, this air-borne vapour becomes crystallized, and descends as snow, accumulating in vast bulk upon elevated lands, and ice barriers to the altitude of mountains; which continue to increase from century to century. A concomitant result is noted in these regions, especially towards the south western edge of the Arctic circle, namely, that the ocean level is rising upon adjacent coast lines, according to observations in West Greenland, and records of deficiency of atmospheric pressure at sea surface, in the higher latitudes of America and north-eastern Asia. It has been also observed that, while the European seas are receding from the shores, and depressing their surfaces, so that straits in the Baltic, formerly navigable, are being gradually closed to shipping, the southern ocean, adjacent to the coasts of Australasia, have evidently undergone progressive elevation during a prolonged period, without any interval of corresponding depression. Also, that while the climate of Europe is gradually ameliorating (and this, although the surrounding seas are,—from diffusion of cold currents, the result of frequent drifts of ice, dissolving in the

north Atlantic,—so cooled as to unfit them for continuing to be the resort of herrings and other marine productions formerly more abundant,) the climate of the higher latitudes in America is increasing in severity; and that of Yakutsk, in north-eastern Asia, within the temperate zone, is thus described by Erman: "Yakutsk lies about two degrees farther south than Drontheim, in Norway, and about the same distance more south than Beresov, on the Obi. Those places are, therefore, much more sparingly irradiated with the sun's beams than the country here, and yet they enjoy an incomparably milder climate than that of Yakutsk." At Yakutsk, Erman "could not expect to find water in a fluid state, till we arrive at the depth of 630 feet, for to that depth the ground is frozen." (*Travels in Siberia, p.* 366-7.) Again, navigation is found, according to Maskelyne, to be free from proximity of ice barriers, to latitude 84½°, north of Spitsbergen, with a northerly prospect of clear sea; while in Behring's Straits, the ice barrier reaches southerly, so as to approach the limits of the Arctic circle; and no instances are recorded, of ice-bergs drifting therefrom into the north Pacific. Similarly progressive alterations of climate are exhibited in regard to the mainland of Cape Horn, in 53½° south latitude, enjoying so mild a temperature, that humming birds are its summer visitants,* contrasting with areas approximating to Australia, which continent appears, as well superficially, as by result of geological observations, to be deteriorating from a tropical to a coolly temperate climate.

Upon these grounds, and regarding astronomical evidences as confirmatory thereto, we submit that the north frigid zone, the portion of the hemisphere receiving, from position, the least solar heat, and of which the pole must be the true centre, is verging south-westward so as to approach the north temperate region; with presumptive evidence in support of similar progressive changes in the southern hemisphere. We thus submit evidence of an apparent deviation of the Earth's polar axis, marked by aberration of the poles from the position on its surface, assigned permanently to them by

* "Parrots and humming birds are numerous in the southern and western part of the Straits, the latter sucking the fuschia and other flowers; in the winter month of May—range to Valparaiso. No such bird inhabits to 53½° north." "Hills of Cape Horn are not covered with snow, even in winter." "The natives of Terra del Fuego are perfectly nude; vegetation also proclaims the winters to be mild."—*See "Voyage of Chanticleer to Southern Atlantic Ocean.' By W. H. Webster. London:* 1834.

geographers. The continuous accumulation of dense and ponderous matter, such as congealed snow and ice, in vast mountain masses, many miles in altitude, in such position on the Earth's surface as increase the polar radii disproportionately, must vary the centre of gravity of the Earth's volume, and induce gravitation of watery particles to such varying centre. The inevitable result, in absence of adequate compensatory influences, must be to cause, and continuously maintain, a deviation of the polar axis, and a consequent change in the position of the Earth upon the plane of her orbit. We cannot assume the correctness of the theory of gravitation at one time, and discard it at another, because its developed action results in production of forces, and their effects, at variance with our prepossessions, or the deductions of our early and greatest philosophers.

The accuracy of scientific theories as to the motions *inter se* of the planets of our system, and respecting the celestial orbs generally, appears vouched for by the precision with which occultations, eclipses, and other phenomena are computed. Yet, astronomic theories may be altogether at fault, as to the accurate definition of the figure of our Earth, its bisection equally by our equatorial line, and the consequent position upon its superficies, of the parallels of latitude, as well as regards terrestrial alterations of longitudes, resulting from a westerly movement of the Arctic pole of the axis of rotation. Sir. J. Herschel in *Outlines of Astronomy*, remarks that "no instruments ever yet invented by man, are delicate enough to indicate, by an increase or diminution of the angle subtended, that one point of the Earth is nearer to, or farther from the stars than another;" calculations accurate as to the stars are therefore not necessarily presumptive of terrestrial immobility of the points upon the globe, of the poles of the axis of rotation. Hence we join issue in the stated belief of certain geologists, that the geological structure of the strata forming the Earth's exterior crust, can only be accounted for, on the hypothesis of such a change of the Earth's axis of rotation. Such change, if continuous, evidently involves alteration in the configuration of the land and seas upon the Earth's surface, progressing gradually throughout ages, in the direction indicated by, and amount proportioned to, the annual change in the position in process of being assumed by the Earth upon the plane of her orbit. As evidenced in past geological epochs, this gradual change is liable to be suddenly accelerated, when a disastrous revolution would ensue,

developing igneous, as well as aqueous agencies, the alternating operation of which, during such convulsions, have been abundantly noted by all geologists. Oscillation of the globe, to regain its equilibrium, would be succeeded by renewed rotation upon an axis passing through its centre of gravity; but the poles of such axis might then occupy an opposite, or totally different position upon the Earth's surface, and thus transpose the relative positions of the arctic and tropical regions now existing.

Sir C. Lyell remarks, "It can be shown that the Earth's surface has been remodelled again and again; mountain chains have been raised or sunk, valleys formed, filled up, and then re-excavated; sea and land have changed places, yet throughout all these revolutions, and the consequent alterations of local and general climate, animal and vegetable life has been sustained." "The changes of ocean level required to swamp continents, are not so great as might be supposed. A rise of 500 feet would sink the sources of the Volga, and drown the most of Europe, 800 feet would sink Basle, 1400 feet the Clyde, 1200 feet the Lake of Constance, 2850 feet the sources of the Danube, 4500 feet would sink the Elbe, and boulders are found as high on European watersheds—in Scotland, Scandinavia, Wales, Ireland, and central Europe! In America, 680 feet would sink Lake Superior, and the bottom of Lake Ontario is below sea level now. If terraces be sea marks, there are terraces on Snowdon, and the Alps at 3000 feet; drift, shells, boulders, and rounded stones, record that a frozen sea, 2000 feet deep, has passed over the sites of London, Edinburgh, and Dublin. Mr. Geikie, in his work on *The Glacial Drift of Scotland*, proves that the land of the British Isles has been submerged to a height which would only leave a few hill tops above water.

The Rev. J. Tenison Woods, F.G.S., states that a recent scrutiny of over 2000 fossils proves that, during the period when the British Isles and Northern Europe were exposed to glacial action, and to partial submergence beneath an icy sea, the southern colonies of Australia abounded in the vegetation and organisms peculiar to tropical climates.

"That the ice epoch, like other great events in Nature, came on gradually and slowly is," it is stated, "abundantly evidenced by the temperate, or even coldly temperate aspects of the flora and fauna of the later, as compared with those of the middle, and earlier tertiaries. Thus, over the tertiary areas, the declension of climate had been going on for ages,

before the advent of the glacial period." The discovery, however, of elephant and mammoth remains, in a comparatively perfect state, on the shores of the Icy Sea, demonstrates that the change of climate occurring at their deposit must have been instantaneous, otherwise and unless the carcases were frozen at moment of deposit, decomposition must have taken place. "The tusks of at least 100 mammoths, or about 40,000 pounds of ivory, are bartered for every year in New Siberia. Notwithstanding the large amount carried away, the supply does not seem to diminish. The remains are scattered along the valleys and near the mouths of great rivers; and, in a number of instances, the mammoth entire has been discovered, with its skin protected by a double covering of hair and wool, and its flesh in such preservation as to afford food for dogs and wild beasts. Whatever the cause of the Siberian mammoth's death, it is certain they were suddenly enveloped in ice, which has not been previously disturbed since they were first entombed." "There is not," says Pallas, "in all Asiatic Russia, a stream or river, in the banks of which are not to be found the remains of elephants and other animals now strangers to that climate."

Hypotheses have been submitted accounting for the above phenomena, by the effect of sudden upheaval, by igneous agencies of the Himalayan range, causing devastating destruction, by force of torrents, resulting from the vast precipitation consequent upon elevation of the summits, far within the limits of perpetual snow. Such hypotheses are, however, quite inadequate to account for the cataclysmal convulsions revealed by geology; which, with due regard to all the phenomena presented, admit of but one mode of explanation, namely, that they have resulted from a sudden change in the axis of rotation of the Earth caused by change of her centre of gravity, and necessary oscillation —involving oceanic disruption—until brought to quiescence by gravitation of all movable matter on the surface to a position vertical to the new centre of gravity. The astronomical position of the Earth, "tilted," as Sir J. Herschel terms it, upon the plane of her orbit, is the evident result, as observations in Nature demonstrate, of the accumulation of the bulk of the waters of the globe in the Southern Hemisphere. What do presently progressing changes prognosticate as to the temporal destiny of a large section of the human race, if, by earthquake disruption, an entrance of the ocean should take place into the vast central cavity

of Asia, now several hundred feet beneath the ocean level; or, if igneous agencies break up and disperse the Polar ice? A sudden loss of equilibrium must ensue, inaugurating a devastating cataclysmal convulsion. Some such contingency is evidently alluded to in Psalm lxxiv. 13—15, as possibly to alter the configuration and position of continents and oceans of the globe, and drift to the wilderness the leviathans of the deep. In view of its probability, though, perhaps, not in our day, nor even in this era of our globe's history, "Men's hearts" may well "fail them for fear, and for looking after those things which are coming on the "Earth." The day of which "shall come as a thief in the night."

Professor Jameson remarks that "the coal formation of East Greenland is the same as that of the great coal mines of Scotland and England. This formation always contains impressions and casts of plants which have a tropical aspect, a circumstance of high interest when combined with the arctic situation of the coal. Remains of plants with tropical characters evidently in their native place of growth under the 75th degree of north latitude, is a fact which naturally leads to very interesting discussions in regard to the ancient forms of the land, and the former state of the climate."

Professor Haughton, in his "Geological Account of the Arctic Archipelago," in appendix to Captain McClintock's work on the Fate of Franklin, &c.," observes that "The discovery of fossils, *in situ*, of the ammonite, evidently belonging to the liassic period, in 76° north latitude, is calculated to throw doubts upon the theories of climate, which would account for all past changes of temperature by changes in the relative position of land and water on the Earth's surface. Besides the ammonite belonging to a warmly temperate or tropical sea, fossils of vertebrata and saurian reptiles have also been found in latitude 76°. If the change of temperature be supposed to be caused by a change of the relative position of land and water, the temperature of Dublin or of some place on the parallel of latitude, must be supposed to be raised to 99° Fahr., while the temperature of the thermal equator will exceed 124°. The theory of central heat also appears to me open to the same objection, as a mode of explaining this remarkable geological fact, for it will simply add a constant to our present climates, leaving the difference to remain as at present to be accounted for by latitude and the distribution of land and water. The

astronomical theory of Herschel also, which would account for former changes of climate, by changes in the radiating power of the sun would only increase the temperature at each latitude, leaving the difference as at present. The only speculation with which I am acquainted, which is capable of solving this *opprobrium geologicorum*, is the hypothesis of a change in the axis of rotation of the earth, the admission of which, as a geological possibility, is mathematically demonstrable, and which has recently had some singular evidence in its favour advanced by geologists. In 1851, I brought forward at the Geological Society of Dublin, a case of angular fragments of granite, occurring in the carboniferous limestone of the County of Dublin; and I explained the phenomena by the supposition of the transporting power of ice. In 1855, Professor Ramsay laid before the Geological Society of London, a full and detailed theory of glaciers and ice, as agents concerned in the formation of a remarkable breccia of Permian age, occurring in the central counties of England; and, still more recently, the same agent has been employed by the geological surveyors of India, to account for the transport of materials, at geological periods long antecedent to those in which ice transport is commonly supposed to have commenced. The motion of the earth's axis would reconcile all the facts known, and it must be regarded as a geological desideratum to determine its amount and direction, and to assign the cause of such a movement. The solution of this problem I regard as quite possible. It is well worthy of remark, that the arguments from the occurrence of coal plants and ammonites strengthen each other; the coal plants rendering the question of light, and the ammonites that of heat, insuperable objections to the admission of any received geological hypothesis, to account for the finding of such remains *in situ* in latitudes so high as those of Melville Island, Prince Patrick's Island, and Exmouth Island."

Professor Ram considers that "nothing less than aberration of the axis of the Earth can adequately account for the varied phenomena forming the problems of geology." The same view has been set forth by other geologists, including Sir Henry James and Mr. Evans, secretary to the Geological Society; but astronomical assumptions have heretofore promptly quelled analysis of the question.

La Place, while maintaining the permanent immobility of the Earth's axis of rotation, hazarded a conjecture that

proximity of a comet might have formerly sufficed to shift it, causing Noah's deluge. Professor Brande observes, "In whatever manner the Earth may have taken its existing form, there are abundant proofs that its surface has been the theatre of many great revolutions. The masses of sand and gravel, and beds of limestone, composed of shells and corals, which are found in the interior of continents, and even to the summits of the highest mountains, plainly show that the present land was once immerged deep under the waters of the ocean. The remains of animals and plants belonging to tropical countries found in the highest latitudes indicate an entirely different disposition of climates from that which now exists." Such convulsions having occurred periodically throughout the vast antiquity ascribed to our Earth by geology, evidence former changes in her centre of gravity, and consequent axis of rotation; and, therefore, demonstrate an uncertainty as to the position upon the Earth's crust now of the original poles, supposed by the Newtonian theory to be flattened by its velocity of rotation, in its primitive condition of an incandescent and molten mass of matter. The present age is one of scientific investigation into principles of causation, and mere recapitulation of the unsupported, if not exploded, hypotheses of our early philosophy, based upon very imperfect knowledge, do not meet the importance of ascertaining the truth, involving the future tendencies of the agencies brought to light.

The observant geologist and student of nature have in Victoria many opportunities for noting the comparatively small deposit, apparently marking the last geological convulsion (universally referred to Noah's Deluge) upon certain localities, disclosing to shallow excavations the proximity of primitive formations, however deep, sedimentary strata of the most recent type may be proved elsewhere. Such observations furnish evidence that the amount of deposition, or even denuding action, of cataclysmal convulsions, is not uniform, or sufficient in all cases to give force to the very common objection against ascribing to ancient edifices, such as those Sir C. Lyell assumes "approach nearest to immortality,—cones, the pyramid, the tumulus, and the cairn," an antediluvian origin; that the very existence of such ancient relics must have been obliterated from view by the necessarily great depth of sedimentary deposit.

Anomalies are occasionally presented to our imperfect knowledge in the aspect and constituent earthy matter and

organisms of rock structure, which are as yet unaccounted for by our philosophy, and thus, perhaps, regarded as subverting the Mosaic version of the period of the human era in our Earth's past history, instead of being really confirmatory of its truth, and furnishing elucidatory evidence in favour of a literal descriptive meaning being assignable to the sacred predictions as to the now looming future history of our wondrous sphere.

Aqueous action, resulting from denudation by the mighty agency of oceanic disruption, is adequate to account for comminution of sedimentary strata, and ultimate re-deposit thereof. And chemical concretion, or igneous vitrifaction of matter so commingled, may account satisfactorily for noted facts respecting the jumbling together of relics of art of ponderous and durable materials, such as pottery, flint implements, &c., of the human antediluvian era, in conjunction with *fossil* organisms of the earlier epochs, in aqueous deposits, from the vicinity of which the lighter carcases of the drowned beings, and their cotemporary animals and vegetable organisms, or fabrics, must have been swept off and accumulated in presently unexplored localities, perhaps ever since concealed in icy regions.

Our investigations justify the assumption that there are moot points as yet undecided between the hypotheses accounting for terrestrial phenomena as viewed by scientific reasoners of the present day, and the tenor of received theories of our early philosophers, based upon data from less perfect sources of information than are now available. Innovations may be humiliating, but truth must be sought for, and, as found, retained at all hazards, even if the whole structure accredited as the science of physical astronomy require remodelling on the basis of ascertainable physical *facts*, and not mere hypotheses backed up by geometric demonstrations of the possibility of their accuracy, and calculations of the momenta necessary, defined with mathematical precision. Although scientific knowledge is wonderfully increased since the era of publication of Sir Isaac Newton's "Principia," yet, still, as remarked by him, the philosopher but wanders with child-like uncertain steps by the margin of the ocean of Truth, securing here and there a pebble-fact of more than ordinary moment, while the boundless expanse of knowledge is beyond, ever tempting him *onward*.

Sir Charles Lyell remarks, "A false theory may render us

blind to facts which are opposed to our prepossessions, or may conceal from us their true import when we behold them." There may be consolation in the reflection that the blindness thus occasionally affecting even earnest scientific investigators has not happened by chance, having been predicted. (See Isaiah xxix. 14.) The up-hill task of demolishing the unsound fabric of theory, based upon long-cherished but fallacious "prepossessions," may be arduous unless light be granted, making it clear that according to Galileo, "Scripture and Nature proceed from the same Source, and are, therefore, incapable of speaking a different language." He pointed out the absurdity of supposing that professors of astronomy would refuse to believe those deductions of reason which appealed to their judgment with all the power of demonstration. Yet Galileo's noblest discoveries were the derision of his contemporaries! Brewster remarks that "men are not necessarily obstinate because they cleave to deeply-rooted errors; nor are they absolutely dull when they are long in understanding, and slow in embracing newly-discovered truths." Therefore we must bear in mind that in questions of science, the *authority* of a thousand is not worth the humble *reasoning* of a single individual. "The simplest ideas," La Place remarks, "are usually those which are the last to force themselves upon us."

ART. XVII.—*On a Remarkable Symmetrically Deformed Skeleton.* By GEORGE B. HALFORD, M.D., Professor of Anatomy, Physiology, and Pathology, in the University of Melbourne.

[Read 24th September, 1868.]

This remarkably deformed skeleton is the property of the Melbourne University. It was purchased for me at Paris in 1862, by Messrs. Raginal and Co., and is stated to have been prepared by the late Dr. Sue. The being, whose skeleton is here represented, with pipe in hand, is said to have played the instrument on the steps of one of the churches in Paris, and to have attained the age of twenty-eight years. Further than this, I have not been able to obtain any information.

The height of the skeleton as it now rests is two feet six

REMARKABLE SYMMETRICALLY DEFORMED SKELETON.

Engraved from a Photograph.

and a-half inches. The general deformity is that resulting from rickets of childhood, from which recovery had occurred as seen in the hardness of the bones. The compressed thorax, curved spine, diminutive pelvis and curved extremities are all sufficient evidence of this. The peculiar deformity, however, consists in the symmetrically blending of the lower ends of the two thigh-bones, which are supported by one leg so as to form one knee-joint only; this being, however, placed directly in a line with the promontory of the sacrum, or if the upright position were assumed immediately beneath the centre of gravity of the trunk. It is evident, therefore, the one foot would, with the assistance of crutches, be an efficient means of support and progression. That this was so, I think, is shown by the forward curve of the tibia and fibula, and by the large muscular impressions on the bowed humeri. It will be seen that the supporting leg and foot correspond to the right of normal skeletons, and on examining the knee-joint from behind, the right femur forms a somewhat larger part of the articulation than the left. In front, however, the patella appears to articulate equally with both.

Short of sawing through and spoiling the preparation, I have examined it as thoroughly as possible, and see no reason to believe it other than a natural deformity, and not an artificially prepared specimen. I can find, however, no record of anything similar, and before leaving England searched the museums for any such specimen, not only in man, but amongst the lower animals. It is certainly remarkable that no former account has been published of this case, as the disposition of the muscular apparatus here would have been very interesting. Perhaps time and opportunity were wanting for the work, or some religious or social scruples prevented it. Much interesting matter relating to deformities in general will be found in Vrolik's "Tabulæ ad illustrandam embryogenesin hominis et mammalium tam naturalem quam abdormen," which is in the University Library.

ART. XVIII.—*On the Black Bulb Thermometer as a measure of the Temperature of Solar Radiation.* By Mr. R. L. J. ELLERY, F.R.A.S., Government Astronomer, &c., President of the Royal Society of Victoria.

[Read 12th October, 1868.]

On the 24th February I read a short paper giving the results of a series of observations of solar radiation, by which I showed that, so far as my observations then went, the ordinary black glass bulb thermometer did not indicate by many degrees the true temperature of the sun's rays, more especially when the solar radiation was large. It further appeared that a thermometer whose bulb was covered with a coating of lamp-black and size gave far more reliable indications; and I pointed out that this was probably owing to the diathermancy of nearly all black glass to the obscure heat rays; permitting them to reach the surface of the mercury inside the bulb, which reflected them back into space.

Since then I have obtained a long series of observations with the same two thermometers, as well as with two others from the Adelaide Observatory, sent to me by Mr. Todd, the results of which do not confirm my former conclusions as to the causes of the differences of indications exhibited by the thermometers then used, but rather lead me to the belief that the *Indications of Black bulb Thermometers generally, as a measure of the Temperature of Solar Radiation are unreliable.*

The thermometers used were four—

No. 1. Thermometer by Grimoldi, of Melbourne, with bulb covered by lamp-black.

2. Thermometer by Casella, of London. Black glass bulb.

3. Thermometer by Negretti and Zambra, of London. Black glass bulb.

Being as follows:—

No. 1	=	— 0·2		No. 3	=	+ 0·3	
2	=	— 2°·0		4	=	... 0·0.	

All four were placed on a suitable stand in the open air, with their bulbs exposed to the sun's rays under exactly similar conditions and their indications, which showed the highest

temperature they had registered during the previous twenty-four hours, were read every morning at nine o'clock. Readings were also obtained at various times throughout clear days so as obtain their indications at other periods than those of maximum radiation.

No. 4. Thermometer by Negretti and Zambra, of London. Black glass bulb.

Nos. 1 and 2 are enclosed in outer protecting tubes of glass, exhausted of air and hermetically sealed ; the enclosing bulbs are about one-inch diameter.

In Nos. 3 and 4 the enclosing tubes are larger than 1 and 2, and are from one-and-a-half to two-and-a-half inches diameter.

No. 4 was compared at Greenwich, and is certified to be correct from 32° to 100°.

In the first place, all these thermometers were compared in heated water with a standard thermometer, and found to have similar corrections amongst themselves at high temperature as at low ones.

These readings were tabulated and the results are as follows :—

No. 1. Lampblack Bulb.	No. 2. B. Glass.	No. 3. B. Glass.	No. 4. B. Glass.
When No. 1 reads from.	Correction.	Correction.	Correction.
60° to 70°	— 3·3	+ 0·7	— 0·7
70 to 80	— 5·3	+ 2·1	— 1·2
80 to 90	— 8·1	+ 5·1	— 0·9
90 to 95	— 9·8	+ 14·9	— 2·2
95 to 100	— 11·3	+ 14·1	+ 1·8
100 to 105	— 11·6	+ 14·5	+ 0·9
105 to 110	— 12·0	+ 14·1	+ 0·4
110 to 115	— 11·1	+ 14·9	+ 0·1
115 to 120	— 12·4	+ 13·7	— 0·8
120 to 130	— 12·9	+ 12·6	— 1·3
130 to 140	— 13·7	+ 10·0	— 2·8

I then tried them by exposing them to heat radiated from a dark body, thus : A sheet of copper, one foot square, with a dull surface, was placed perpendicularly, and a large Bunsen's burner made to play on one of its surfaces, so as to heat it at about the centre. Thermometers Nos. 1 and 2 were now arranged on a stand, so that their bulbs were both as nearly as possible three inches from the centre of the

other surface of the sheet of copper. As the copper got heated and radiated, the thermometers commenced slowly to rise until they reached an indicated temperature of 150°, when the burner was removed and the temperature fell to about 80°. Readings were obtained at every 10°, both whilst they were rising and falling. Nos. 3 and 4 were compared with No. 1 in the same way. The results were as follows: No. 2 behaved almost exactly as it did under solar heat; the difference between its indications and those of No. 1 increasing with the temperature until when No. 1 read 145°, No. 2 indicated only 130°.

No. 3 was exceedingly slow in rising. At 90° with No. 1 it was 12° behind; at 100°, 70° behind; and at 120° it was 23°; at 150°, however, it was only 14°·5. The highest temperature indicated by No. 1 was 150°, while No. 3 reached 140° a considerable period after No. 1 had ceased to rise. A second experiment gave almost identical results. It was found, however, that No. 3 continued to increase its indications after the source of heat was removed, but never reached the temperature indicated by No. 1. In cooling, too, it fell very slowly, reading 125° when No. 1 read 109°, and so on. The surrounding bulb is about two and a half inches diameter, and of very thick glass. It remained hot a long time after the bulb of No. 1 was quite cool. No. 4 was now tried against Nos. 1 and 3. The relations between 1 and 3 were the same as before, while No. 4 (the one tested at Greenwich) read 3° more than No. 1 at 80°, 6° more at 120°, 5° at 138°, and 3° at 145°; and they increased and decreased in their indications simultaneously. No. 4 has a surrounding bulb of about one inch and three-quarters and the glass is thin, while that of No. 1 is about one inch diameter and of somewhat thick glass.

These results are not quite confirmatory of the belief which I expressed in my former paper, that coating the black glass bulb with some dead opaque pigment, so as to destroy every trace of diathermancy, would render the indications of solar radiation thermometers more reliable and intercomparable. The anomalous results obtained from No. 3 are somewhat inexplicable. Exposed to the sun's rays this thermometer always indicates the highest temperature of all four; exposed to radiant heat from a dark surface it is quite the reverse; it is found to be exceedingly slow in absorbing the heat rays, and equally slow in parting with them; and it was observed that the mercury continued to rise for several

minutes after the source of heat was removed—it would almost seem as if the thick surrounding bulb intercepted the heat rays and stored them, giving them out slowly to the black bulb after the external feed had ceased. No. 4 (the one tested at Greenwich) which has an ordinary black glass bulb with a thin surrounding bulb, was the quickest to absorb the heat from the dark body, and indicated the highest temperature of all four. The one with the blackened bulb (No. 1) was the next in order, and rose almost as rapidly as No. 4, but fell short of its indication by 6° at temperatures above 120°. These two read nearly alike at all temperatures when exposed to the sun.

So far as these observations go, they seem to show that the usual methods of measuring the "heat in the sun" are fallacious; that among four excellent black bulb thermometers from good makers the differences at high temperatures are sometimes as much as 28° Fahrenheit; and when one is bearing sun's rays at 145° or 150° it is certainly not satisfactry too find the thermometers indicating only about 120° or 125°. We may, I think, safely conclude that some more reliable and accurate instruments are required for the purpose than those usually adopted; ann although it is probable that a careful selection of the glass used and a strict adherence to one form, size, and as near as possible the same thickness in the construction of the outer bulb, would reduce the discrepancies to a large extent, there is something more required in the material of the black bulb itself than usually exists in these now used. Tyndal, in his little book on *Radiation*, note page 29, says: "The black glass chosen for thermometers, ahd intended to absorb completely the solar heat, may entirely fail in this object if the glass in which the carbon is incorpored be colourless. To render the bulb of a thermometer a perfect absorbent, the glass with which the carbon is incorporated ought in the first instance to be green."

This may be accepted as the best way to make the black glass bulbs; but it is also essential, I believe, to have the surface dead, and not polished, as the ordinary surface of glass always is. With bulbs made of such glass, with the surface deadened, we should probably have a reliable thermometer; but the necessity for protecting the bulb from currents of air involves other questions which I have pointed out, and which I believe, require fnrther experiment for their solution.

Art. XIX.—*On the Earthquake Wave of the 15th August, 1868.*

[Read by the President, R. L. J. Ellery, Esq., 29th October, 1868.]

The President gave a brief account of the unusual waves which were experienced on the shores of some of the Pacific islands, New Zealand, and Australia, on the 15th of August last, which he stated were undoubtedly the result of the frightful earthquakes which occurred along the west coast of South America on the 13th August. He had obtained the local times of the occurrence of the waves at Apia, or Charlotte Island, of Gilbert's Group in the North Pacific; at Lyttleton, New Zealand; at Sydney, Adelaide, and King George's Sound. The waves had been experienced at many other places, but he had not got the times with sufficient precision to make any use of them to obtain the rate at which the sea disturbances must have travelled. The waves at King George's Sound—the most westerly point at which they were noted—were weak but "notable." At Adelaide they were unmistakably remarked at 7 a.m., 10 a.m., and again at 4 p.m. At Sydney the tide gauge showed the first disturbance at 2.30 a.m. on the 15th, but the greatest effect took place five hours later. At Newcastle 7.24 a.m. it swung the ships at anchor around, and washed boats on shore. In New Zealand and Chatham Islands the wave rose from four to eight feet, doing considerable damage on the low-lying coasts. In Savaii, in the Navigators Islands, it rose fifteen feet on the east side, while at Apia much further north and east, it rose as high as eight feet.

From intelligence last received from Callao, it appeared that climax of the earthquake took place there at about 5.15 p.m. local time, although further south it did not happen till 9 p.m. Assuming the time at Callao, therefore, as 5.15 p.m. on the 13th, the corresponding Greenwich time would be about 10.19 p.m. on the 13th. The times of occurrence of the waves at the various points, as well as their approximate distances from Callao, were given as follows:—

Locality.	Greenwich Time of Occurrence.	Time Occupied by Transit.	Approx. Distance from Callao. Naut. Miles.	Rate of Transit. Miles per Hour.
	D. H. M.			
Apia, N. Pacific	14 2 28	15.48	6590	417
Lyttleton, N.Z.	14 4 20	17.36	5720	327
Sydney	14 6 10	17.30	6907	394
Adelaide	14 11 40	25 00	7383	295
King George's Sound ...	14 12 28	25.30	7846	308

He pointed out that there appeared to be a retardation of the wave as the distance from the centre of disturbance increased; and that the late hour at which it was felt at Adelaide would be accounted for by the position of that place with respect to the southern coast line of Australia. It was also suggested that the apparent retardation might be the result of assuming the centre of disturbance too far east from the Australian coast: at Callao, for instance, whilst it might really have been in the Pacific a long way to the west of that place. If such were the case it would make the rates of the wave transit much more equable. The average rate of transit, omitting Adelaide, was 381 miles per hour; in the great earthquake at Simoda in Japan in 1854, the rate of transit, from observations made at San Francisco, was 370 miles per hour.*

Art. XX.—*Notes on the Secondary Beds of Northern Australia.* By H. A. Thompson, Esq.

[Read by Mr. Rawlings, 9th November, 1868.]

Some time ago a considerable degree of interest was taken in the papers read by Professor M'Coy, bringing under the notice of the Royal Society the existence of secondary rocks on this continent, as indicated by the fossil bones of the ichthyosaurus and pleisiosaurus, and cretaceous shells discovered on the Flinders River, near the Gulf of Carpentaria.

Having lately crossed the country where these organic remains were found, it may be of some interest to communicate the few observations that were made in the course of a rapid journey from Cleveland Bay on the east coast to the

* Mallet's Report on Earthquakes. Brit. Assoc. Report, 1858, page 126.

parallel of the 140° of the east longitude, and between south latitudes 19° and 21°.

The object of the journey was to examine the outcrop of copper ore, discovered on the head-waters of the Cloncurry river in latitude 20° 42′ south. The appended sketch-map shows the route followed, and the section is intended to represent the outline and character of the formations on the line travelled over.

This section of country may be divided into three parts :—first, the coast lands, and the belt of high table land constituting the coast range ; second, the wide valley west of the coast range known as the Flinders Plains ; and, third, the hilly country bounding the Flinders Plains on the west, known as the M'Kinlay Ranges.

In this portion of eastern Australia, the coast range approaches close to the sea, and the high rugged islands off the coast, together with the spurs and outlying hills between the eastern escarpment of the range and the present coast line, shows that the sea has made extensive inroads into the eastern side of the table-land.

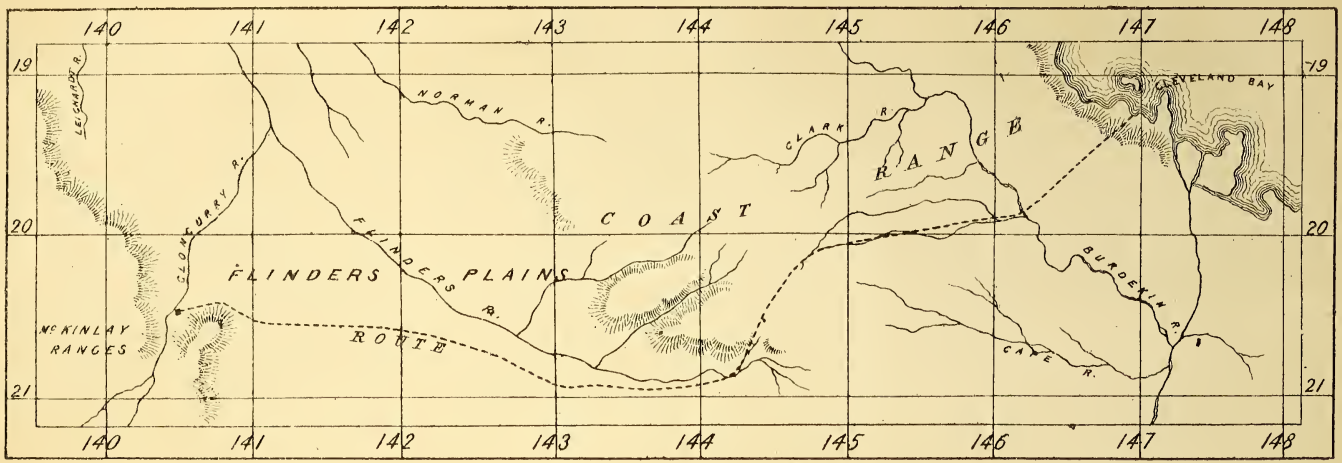
Near Cleveland Bay, the main range is between twenty and thirty miles from the sea ; the intervening country consisting of gently rising plains ; broken by spurs running at right angles to the range, and detached hills rising abruptly from the low ground.

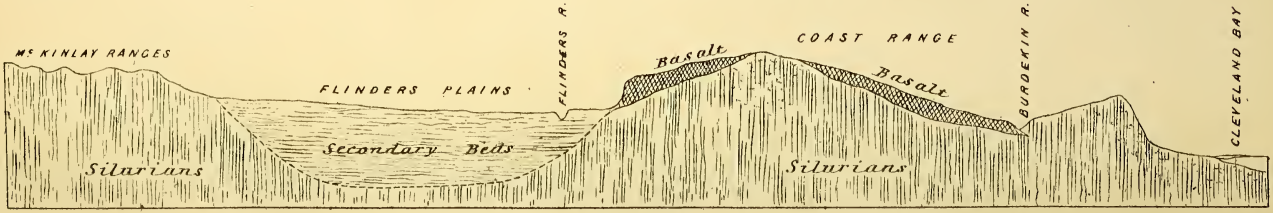
On the eastern face, the main range presents a bold and rugged front, between 2,000 and 3,000 feet in height, so precipitous that the existence of the small settlements on the coast generally depends on the discovery of a practicable road up this face, to enable a trade to be carried on with the interior.

The amount of denudation effected by the streams running through these coast plains is not so great as to indicate the lapse of any long period of time since their elevation above the sea, and a small depression of the land would convert the hills into a bold, rocky coast with deep bays and inlets.

From the summit of the range the ground falls towards the Burdekin River, which is crossed at a distance of seventy-five miles from the coast. Beyond the Burdekin the country rises gradually for about one hundred miles to the ridge forming the water-shed to the interior.

The total width of this table-land running parallel with the east coast is over two hundred miles. It is traversed from north-west to south-east by the great longitudinal


140
141
142
143
144
145
146
147
148
19
20
21
LEICHHARDT R.
NORMAN R.
CLONCURRY R.
FLINDERS R.
CLARK R.
RANGE
COAST
CLEVELAND BAY
FLINDERS PLAINS
BURDEKIN R.
McKINLAY RANGES
ROUTE
CATE R.


McKINLAY RANGES
FLINDERS PLAINS
FLINDERS R.
Basalt
COAST RANGE
Basalt
BURDEKIN R.
CLEVELAND BAY
Secondary Beds
Silurians
Silurians

SECTION

valley of the Burdekin, having a course of some four hundred miles, and then joining a similar valley coming from the south, when the united waters break out of the table-land and escape to the east coast. The Burdekin is fed by tributaries coming from each side of the valley; but the western side is the principal drainage area.

From the coast to the top of the range the road passes over granite rocks, and beyond this the same rock alternates with bands of silurians up to the east bank of the Burdekin. The western bank consists of basaltic rock, and the present river-channels is of modern date, worn out on the line of junction between the basalt and the silurians, after the deeper part of the old valley had been covered up by the volcanic rocks.

Leaving the Burdekin, the road passes over basaltic rock for about one hundred miles, when the auriferous formation near the head of the Cape River crops out. This consists of bands of metamorphosed silurians, from whence specimens might be selected in all stages of the change from a schistose to a granitic character. Beyond this granite again prevails, and then the older rocks are covered up with basalt up to the edge of the Flinders Plains. The road from the range leads down a gorge worn in the volcanic rock, which at its junction with the Flinders River must be over three hundred feet in depth.

This escarpment forms the western flank of the coast range, and from it extends the country known as the Flinders Plains, to the coast at the Gulf of Carpentaria on the north, and to the M'Kinlay Ranges on the west, the latter being a distance of some two hundred miles.

This wide valley is nearly level country, with slight depressions in the neighbourhood of the larger water courses. Where crossed, its main drainage-channel is the Flinders River running to the Gulf, and receiving many tributaries from the west, having their origin in the M'Kinlay Ranges. Some fifteen of these small creeks were struck in travelling across the plains from the Flinders to the Cloncurry, and the latter river joins the Flinders about one hundred miles north of the line travelled over. These water-courses frequently spread out into numerous branches in the level plains, and in some places it is difficult to make out which is the main channel. At the Flinders and Cloncurry rivers, there is a narrow belt of timber on each side of the stream, then green banks from ten to thirty feet deep, and between these a wide

bed of dry white sand and gravel, with water-holes at uncertain intervals, more frequently found in some of the ana-branches than in the main channels; but water may generally be procured by sinking wells in the sandy beds of the larger rivers.

The tributary creeks have much the same character on a smaller scale; but in these the timber is confined to a single line round the water-holes, and the plains are for the most part treeless.

After heavy storms a torrent may roll down these water-courses for a few days, but when the rain ceases they soon resume their usual arid appearance.

The soil is sandy and loose, rising up in a spongy mass in wet weather, when many parts of the plains become nearly impassable, and in dry weather opening in innumerable fissures. Miles of country may be ridden over without seeing a square yard of unbroken surface. This character will of course be greatly modified as the surface is trodden firm by stock.

In all the sections observed, the underlaying formation was a fine-grained sandstone in horizontal beds, apparently undisturbed. Flattened nodules of limestone, often enclosing fossil shells, were scattered about the surface in many places; but no limestone beds were seen.

Cretaceous shells were picked up on the Flinders River, near the centre of the plains, and near the junction of the horizontal sandstone beds with the rocks of the M'Kinlay ranges.

The place where the bones of the ichthyosaurus and pleisiosaurus were found is on the point of a low rise bounding the flats of the Flinders River, and about six miles from its present channel. Here we have the same sandstone formation in horizontal beds; but the saurian bones, and most of the shells, were found on the surface of the soil. The first discoverer of one of the saurians described it to me as presenting the exact appearance of an animal, whose body had decayed on the surface, leaving the skeleton on the grass. The singular position in which these shells and bones are found is evidently owing to the friable nature of the sandstone in which they have been enclosed; the slow disintegration and gradual removal of this rock having at length left the harder fossils on the surface.

In some places where the rock was exposed the apparently hard stones crumbled to pieces in the hand, indicating the

source from whence the sandy alluvial deposit of the plains had been derived.

Several of the shells brought down were broken from the sandstone rocks, where they had formed layers of organic remains on the bedding planes.

Approaching the western edge of the plains, the M'Kinlay Ranges are first seen at a distance of thirty to forty miles, but the Silurian formation, of which they consist, extends for some miles into the plains. The only portion examined was a bight or hollow in the range, where it trends back to the westward (the general direction being north and south), and whence the drainage of a considerable area makes its escape to the plains through the Cloncurry River and its tributaries. This portion of the country is slightly undulating, studded with detached hills, and crossed by low ridges, with the rock here and there cropping above the surface of the ground. Occasionally detached masses of rock rise abruptly on the line of these ridges from twelve to fifty feet in height—or peaks and oblong hills follow the same lines. The country shows no sign of active denudation, and its present form is due to the slow disintegration of the rock, and the gradual removal of the finer particles. All the gravel observed was angular, both on the surface and in a shaft sunk in the bed of a small creek when looking for water. Rolled drift will probably be found in the bed of the Cloncurry River and some of the larger streams.

The detached masses of rock and small hills in most instances consist of rock impregnated with iron, or changed into quartzite. In one place a low rise was crested for several hundred feet by a quartz vein from five to six feet wide and from twelve to twenty feet high, cropping up white and bare above the grass, with vertical sides and sharp angles, giving little indications of wear. In these cases the hardened rock or quartz had resisted the action of the weather, while the softer rock decayed, and was gradually washed away.

To a certain extent the same may be said of the low ridges—these consisting of ironstone, quartzite, and in some places a semi-granitic rock. The constituents of the latter form of rock seemed to be collecting into separate bodies, so as to resemble a coarse granite; and in the weathering of the rock the softer portions had been worn away, leaving the harder parts projecting on the surface, and rounded by exposure, so as to resemble a conglomerate, for which it was

at first mistaken. All these forms could be seen on the same ridge, but the trenches proved that this change only affected the surface, and did not penetrate to any depth.

The prevailing rock was a sandy schist, but bands of slate with vertical cleavage, and masses of porphyritic and granitic rocks, were mixed with it. Patches of dolomite, both in the grey compact and white crystalline form, were also met with at intervals. No fossils were found in these rocks, so that their exact position cannot be determined; but I have no doubt as to their being Silurians, which have undergone metamorphic action, similar to that affecting the same formation in the coast range.

Traces of copper ore are found in great abundance, and one very rich and extensive deposit of red oxide of copper has been partially opened; while, considering the small area yet explored, it is probable many productive mines will be discovered in these ranges. Even now there will soon be a large mining establishment on the river, down whose banks Messrs. Burke and Wills toiled in their journey to the Gulf.

One singular fact noted in these ranges was the distance to which the heat had penetrated into the ground. In a shaft sunk to a depth of fourty-four feet there was no diminution in this heat. When leaving the hot midday sun of the tropics, going down this shaft produced a feeling similar to that sustained on entering a Turkish bath. The rock at the bottom felt warm to the hand, and in two or three minutes after reaching it the perspiration burst from every pore.

It will be interesting to mark the depth at which a mean temperature will be found in this mine.

However incomplete these observations—made during a hurried journey, and for the most part from the saddle—necessarily must be, they yet establish the fact that between the coast range and the M'Kinlay Ranges there has existed a deep depression or valley, extending from the Gulf of Carpentaria to the twenty-first degree of south latitude, and that this depression was filled by the sea during the secondary era for a period long enough to allow of the deposition of the sandstone beds, from whence the fossils described by Professor M'Coy have been obtained; and further, that these secondary beds show no indication of disturbance, or of active denudation.

Limited as this knowledge is, it may form a starting-point for other observers, whose accumulated discoveries will un-

ravel the history of the continent during this epoch, and much valuable information may perhaps be obtained by pointing out the questions requiring solution.

1. Does the depression in which these secondary beds have been deposited extend across the continent as an arm of the sea, or is it a large inlet, and if it is the latter, where does it terminate?

About 100 miles south of the route followed we have the watershed between the streams running to the north, and those running south into Cooper's Creek. This is a likely point for the supposed inlet to terminate, and it should be examined to see if the silurian rocks stretch across from the coast range to the M'Kinlay Ranges. If the depression has been an arm of the sea running from the north to the south coast, and dividing the continent into two or more islands, by what line does it reach the southern coast? This ought to be readily traced, for the horizontal sandstones may be easily distinguished from the silurian sandstones with vertical cleavage even by an inexperienced eye. Can these beds underlay the alluvium of the Lachlan and Lower Murray plains, or do they find a passage to the westward by the valley of Cooper's Creek, dividing the M'Kinlay Ranges from the Barrier Ranges west of the Darling?

2. Does the M'Kinlay Ranges form the western boundary of the inlet or strait, or has this range formed a promontory projecting into or been an island in the secondary sea?

This question as to the extension of the secondary rocks to the westward is a very interesting one. All I have been able to make out is, that the silurians are found on the Gregory, and the upper waters of that river are running through basaltic plains. The secondary rocks must be found to the westward of this river if they extend in this direction.

3. Has the secondary formation originally extended over a much larger area than it now occupies, and since been denuded?

If such has been the case, some patches of these secondary rocks will most likely be discovered mixed with the adjoining silurians, or at least some fossils may be found, indicating these rocks have covered the silurians.

Judging, however, from the undisturbed character of these rocks, and the absence of rolled drift, or any indication of strong denuding action, I believe this question will eventually be answered in the negative.

ART. XXI.—*Descriptions of some new Genera and Species of Australian Polyzoa; to which is added a List of Species found in Victoria.* By P. H. MACGILLIVRAY, A.M., M.R.C.S.

[Read 26th November, 1868.]

In the present paper are given descriptions of forty-eight Species, including two Genera, of Australian Polyzoa, which cannot be satisfactorily referred to any of those hitherto described. The identification of Polyzoa by the aid of descriptions alone, however accurate these may be, is often extremely difficult. The species here described, as well as the others existing in Victoria, will be figured in Professor M'Coy's "Memoirs of the Museum," where I hope to be able to give descriptions of all those with which I am acquainted. Specimens will also be deposited in the National Museum. I have added a list which contains all the Victorian species I have in my collection, with the exception of a few not yet determined.

Family CATENICELLIDÆ.

Genus CATENICELLA, *Blainville.*

C. rufa.

Cells vase-formed; lateral processes small, pointed. Front of cell pierced by numerous round fenestræ, the circumferential being the largest; mouth with a notch in the lower lip. On the back of the cell an elevated band runs up the middle, sending a narrow branch horizontally to each lateral process, and a small band extends up each side. Ovicells large, cribriform, surmounted by two avicularia.

Common, forming handsome reddish-brown tufts, four or five inches high.

The only species with which this can be confounded is *C. cribraria*, Busk, from which, however, it is easily distinguished. In *C. cribraria*, the lower lip is entire, and there is a crescentic pore a short distance beneath it; and the back is smooth and destitute of any special marks. In *C. rufa*, instead of the suboral pore, the centre of the lower lip presents a constant notch; the avicularian processes are small and pointed, and the back of the cell is occupied by a broad mesial band,

connected inferiorly with two narrow lateral ones, and sending off superiorly, on each side, a narrow band to join the lateral in the avicularian processess. The ovicell of *C. rufa* is very large, cribriform and surmounted by two avicularia. I am unacquainted with that of *C. cribraria.*

C. intermedia.

Cells large, wide ; mouth vertical, or nearly so ; front of cell with five large fenestræ ; lateral processes very wide, usually abortive on one side ; back of cell smooth.

Queenscliff.

From *C. plagiostoma,* to which it is closely allied, it may be distinguished by the following characters: The mouth is straight or nearly so ; the anterior foramina, although arranged in the same manner, are of smaller size ; there are none of the peculiar enormous spoon-shaped avicularia of *C. plagiostoma ;* the back also is smooth. The large size of the foramina, and the very wide lateral processes sufficiently distinguish it from *C. ventricosa,* Busk, the only other species with which it can be confounded. The large lateral process, with its tolerably large avicularium, usually exists only on one side of the cell.

C. Hannafordi.

Cells wide, ovoid or sub-globular. Lateral processes large, gaping, directed forwards, usually equal on both sides. Vittæ narrow, entirely lateral, extending the whole length of the cell. Anterior surface smooth or very finely papillose ; posterior surface faintly sulcate.

Lady Bay, Portland, adhering to Algæ—Mr. S. Hannaford.

This species may be distinguished from all the others by the large gaping avicularian processes, directed a good deal forwards, and almost surrounding the mouth, and the narrow, entirely lateral vittæ. Its closest ally is *C. ringens,* which has not hitherto been found in Victoria, and of which I have not seen specimens.

Family CELLULARIIDÆ.

Genus EMMA, *Gray.*

E. cervicornis.

Cells two in an internode ; internodes connected by short double tubes ; aperture armed with five or six spines, of which the two outer are long and pod-like ; opercular spine ranched, projecting upwards and outwards from the inner

and lower angle; lower part of cell-aperture filled in by a calcareous tubercular plate; a large avicularium on the outside of each cell immediately below the aperture.

Parasitic on other polzyoa and algæ.

Of the genus *Emma*, four other species are of common occurrence in Australia. Of these *E. tricellata*, Busk, and *E. (Menipea) Buskii*, Wyv. Thomson, are at once distinguished from the present by having three cells in an internode. *E. (Menipea) Cyathus*, W. Thomson, and *E. crystallina*, Gray, agree in having only two cells; in the former, however, the connecting tube is very long and single, while in the latter, in which it is double, there is no opercular spine.

Family SALICORNARIIDÆ.

Genus SALICORNARIA, *Cuvier.*

S. hirsuta.

Cells in the same series contiguous; surface granular; mouth central, lower lip arched upwards, usually with a minute denticle at either side internally; a long corneous tubular process from the base of the cell. Avicularium replacing a cell, mandible very large, semicircular.

Common.

This species forms bushy tufts one to two inches high, of a dirty-white colour. The cylinders frequently present, towards the superior extremity, swollen portions corresponding to the situation of the immersed ovicells. The form of the cell varies extremely, being hexagonal, rhomboidal, with upper and lower edges straight, or the upper arched or pointed; frequently the upper end is arched, and the lower part much contracted. The forms of cell are precisely similar to those described as occurring in *S. farciminoides* and *S. sinuosa*. At the base of each cell there is generally a long, hollow, corneous process; in some specimens each cell has two; and occasionally they are wanting, but never from all the cells of a polyzoary. The ovicell is totally immersed, situated at the swollen part of a cylinder; the opening is widely lunate, at the summit of an ordinary cell. The avicularium is of great size. It takes the place of a cell in a series; it is larger than the adjacent cells, of a similar form, granular on the surface; the mandible is very large, semicircular, occupies about a third of the cell, and from its situation and form very much resembles the moveable lip of an enormous mouth.

Family BICELLARIIDÆ.

Genus BICELLARIA, *Blainville.*

B. turbinata.

Cells elongated, much contracted below ; opening circular or nearly so, directed obliquely upwards and forwards ; usually four long, submarginal spines.

Queenscliff, a single specimen.

The general appearance of this species is very much that of *B. grandis*, Busk, from which, however, and *B. Tuba* it is readily distinguished. It differs from the former in the shape of the cell and direction of its opening, which is nearly round, and looks upwards and forwards, and from the latter in the absence of the peculiar spine-bearing process from the outer margin. In the more perfect cells, there are generally four, long, hollow, articulated, submarginal processes, of which two arise almost together from the outer part, one from the upper edge, and the fourth, longer and directed more vertically, from the anterior edge. The aperture is usually occupied by a thin membrane, in the outer half of which is the semi-circular mouth.

Genus BUGULA, *Oken.*

B. robusta.

Cells biserial, contracted below, upper and outer angle produced into a short, hollow conical process ; aperture oval, not extending to the base. A large avicularium on the lower part of the cell, below and to the outside of the aperture.

Western Port.

Of this species I have a tuft nearly two inches high. It is of a greyish-brown colour. It is readily distinguished from the other described species. The cells are large, the whole outer angle produced into a stout, conical process ; the inner angle is rounded, and has no spine or prolongation. The aperture does not extend to the base ; and on the entire part of the cell, to the outside and below the level of the aperture, is a large pedunculate, avicularium. I have not seen ovicells.

Family HIPPOTHOIDÆ.

Genus HIPPOTHOA, *Lamouroux.*

H. crassa.

Cells large, much attenuated downwards, surface not carinate ; opening large, margin thickened, a thick lip-like projection from the lower border. Connecting tubes short.

On stones and algæ.

This species is closely allied to *H. catenularia,* from which it differs in the thick projection from the lower margin of the mouth.

H. distans.

Cells small, carinate, smooth or longitudinally striated ; mouth small, lower lip entire ; connecting tubes very long, slender and annulated. Ovicell small, projecting from the upper part of a cell.

On stones and algæ.

This species is at once recognised by the small size of the cells, the entire or slightly projecting lower lip of the small roundish mouth, and the great length of the slender connecting tubes which are usually many times the length of the cell. The ovicell projects from the upper part of a terminal cell, resembling a prolongation upwards, and has a short, obtuse conical process above or in front.

Genus ALYSIDOTA, *Busk.*

A. ciliata.

Cells ovate or pyriform ; front smooth ; mouth with four to six spines ; a small lunate pore below the mouth. Ovicell adpressed to the cell above, globular, smooth, grooved above.

A single small specimen on a fragment of Bicellaria.

Family MEMBRANIPORIDÆ.

Genus MEMBRANIPORA, *Johnston.*

M. Woodsii.

Cells oblong, arranged in longitudinal and transverse series ; margins raised ; mouth large, arched above, concave below, with a blunt hollow spine on either side. Avicularium at the base of a cell, mandible broadly triangular, with the angles rounded.

Portland bay, on algæ—Rev. J. E. T. Woods.

In this species, the horizontal rows of cells diverge obliquely from a mesial line. It may be distinguished from

M. mamillaris by the cells being arranged in transverse series instead of being alternate and by the different form of the avicularium; and from the following species by the cells being of uniform size, by the hollow lower lip of the mouth, and by the oral spines, although frequently differing in size, not presenting the same great disproportion.

M. dispar.

Cells oblong, of two sizes, arranged in concentric series, a row of large cells being followed by two rows of short; margins raised; mouth arched above, straight below; a thick, blunt, hollow spine on each side of the mouth, in the large cells of enormously disproportionate size.

Portland Bay, on algæ—Rev. J. E. T. Woods.

The characters of this species are so peculiar that it is impossible to confound it with any other. The cells are of two sorts, the one form about twice the length of the other. One row of long cells is succeeded by a double row of short ones. In the short cells, the oral processes are of nearly equal size, while in the long ones there is on one side of the mouth a small or moderate sized spine, and on the other a large bullate process.

M. armata.

Cells elongated, quadrate, separated by raised margins; aperture entirely filled in by a thin, granular membrane; mouth with a thick hollow process on each side. Avicularia large, usually at the base of a cell, mandible pointed directly upwards.

On algæ, Port Phillip.

M. serrata.

Cells quadrate, very much elongated, truncate above and below; from each side of the margin projecting inwards is a series of short processes expanding and dividing at the ends. Avicularium at the base of a cell, mandible very long. Ovicell small, projecting into the base of the cell above.

Encrusting a sponge, Snapper Point.

At once distinguished from all other species by the curious marginal processes, which bear some resemblance to those found in some forms of *Flustra denticulata*, of which, were it not for the absence of the characteristic minute denticles and the much longer and narrower mandible of the avicularium, it might be supposed to be a single layer.

M. falcata.

Cells obscurely hexagonal, separated by raised beaded margins; front in great part filled in by a tubercular calcareous plate. Avicularia scattered irregularly, replacing a cell, mandible large, falciform. Ovicell small, round, granular.

Snapper Point, on a mussel shell.

M. ciliata.

Cells broadly ovate, separated by narrow raised margins; front of cell almost entirely occupied by a calcareous, granular, membrane; a series of (4–7) long, hollow spines articulated round the upper end of the cell.

On Algæ, frequent.

This very peculiar species occurs in small patches on algæ. The cells are irregularly arranged, separated by narrow raised margins; the greater part of the front is occupied by a calcareous tubercular plate, the upper margin of which has a thickened rim; the aperture left is small, and from the size and shape and the arrangement of the spines, might readily be mistaken for a mouth with a straight thick lower lip. Round the margin of the cell opposite the aperture, there is a series of long, thick, articulated, hollow spines. These are so long as, in many specimens, greatly to obscure the cells underneath. In some specimens, on narrow algæ, the front of the cell is much thinner and quite smooth.

Genus LEPRALIA, *Johnston.*

L. vittata.

Cells ovate, separated by irregularly reticulated spaces; front of cell with a broad vitta commencing below the mouth and extending to near the base of the cell, and a row of small perforations on each side close to the margin; mouth arched above, nearly straight below. A roundish or pyriform avicularium above each cell.

On oyster-shell from Western Port.

A beautiful species, at once distinguished from all others by the peculiar anterior vitta.

L. ferox.

Cells confused, coalescent; front pierced with several large apertures; mouth large, with 1–3 small denticles on one side; lower lip occupied by an enormous avicularium.

On Sargassum, Williamstown; on algæ Queenscliff.

This species forms small thick layers encrusting algæ.

The cells are quite undistinguishable. They are pierced by several large openings. The mouth is very large, and usually has on one side two or three sharp denticles. The lower lip forms a large projecting mucro hollowed on one side for an avicularium, and round on the other, from which also frequently projects a mamilliform process. The avicularium faces that side of the cell mouth on which the sharp denticles are situated. In some specimens there are two or three short rounded processes on the upper lip.

L. mucronata.

Cells elongated, of small size, in radiating series. A single median avicularium below the mouth, situated on a projecting mucro, mandible on the anterior surface, pointing directly upwards. A stellate pore in the middle of the cell.

Queenscliff, on shell.

This species is at once distinguished by the central, stellate pore, and by the suboral avicularium. The cells are long, narrow, arranged in radiating series, which are separated by furrows, in the bottom of which can sometimes be distinguished a narrow raised line; sometimes the extreme margins are areolated. The front of the cell is finely granular or frosted; about or below the middle is always a large, round, stellate pore. Immediately below the mouth is a median avicularium, the fixed part of which forms a mucro projecting beyond the lower lip, and the mandible of which is pointed directly upwards and opens in front.

L. diadema.

Cells broad; mouth straight below, arched above, with several spines; a central, roundish pore below the mouth; the edges of the cell obscurely grooved. An avicularium on each side below the mouth, mandible long and pointed outwards; sometimes an avicularium only on one side. Ovicell encroaching on the cell above, with a broad band of vertical beaded lines round the upper margin.

On algæ, Williamstown and other places.

L. ceramia.

Cells obscurely rhomboid or hexagonal, areolated in front; mouth arched above, with three or four spines, straight below; a lunate pore in front below the mouth. A large avicularium at one side of the mouth, mandible long, pointed, directed downwards. Ovicell imbedded in the cell above, sculptured round the upper margin.

Queenscliff, on Laminaria, a single specimen.

This species bears some resemblance to *L. Diadema*, from which it is distinguished by the areolation of the cells and the single avicularium at the side of the mouth, the mandible of which is long and directed downwards.

L. trifolium.

Cells distinct, irregular in shape, frequently oval, granular; mouth trifoliate, the angles of the trefoil frequently produced into spines. Avicularia, when present, by the side of the mouth, mandible long, pointed. Ovicell of moderate size, globular, granular.

On shells, stones, and algæ, probably common.

L. larvalis.

Cells elongated, confused, pierced towards the base by a variable number of foramina; two large openings about the middle of the cell, with a prominent ridge running between them to the point of the much projecting, triangular lower lip; mouth arched above, and frequently with a spine on either side on the angle of junction of the upper and under lips. Avicularia large, on the side of a cell below one of the large openings.

On Sargassum and other algæ, probably common.

L. circinata.

Cells smooth in front, with a row of stelliform pores round the edge, extending also above the mouth; mouth with two or three spines above, lower lip straight with a minute notch. Ovicell adnate to the cell above, very slightly grooved on its upper border.

Queenscliff, on algæ.

Closely resembles *L. Malusii*, from which it differs in the absence of the central lunate pore, in the notch in the lower lip, and the very faint grooving of the ovicell.

L. papillifera.

Cells ovate, distinct, surface covered with numerous hollow granulations or papillæ; mouth usually with several hollow processes and with the lower lip much produced. Ovicell large, round, and covered with hollow granulations like those of the ordinary cells.

Williamstown, on algæ.

This species is distinguished by the whole surface of the cells and ovicells being covered with short, round, irregular papillæ.

L. megasoma.

Cells large, distinct, oblique ; surface smooth or obscurely grooved ; mouth large, edges thickened, lower lip with a shallow notch.

Queenscliff, on mussel shell.

L. crystallina.

Cells large, irregularly hexagonal or rounded above, separated by narrow raised lines ; regularly minutely tubercular in front ; mouth rounded above, lower margin straight, with a deep rounded notch.

Queenscliff, on old shell.

In this very beautiful species the cells are wide, projecting little ; at the bottom of the hollow between contiguous cells there is a narrow raised line ; the front is thickly covered with small, round tubercles, except in the middle, a small portion of which is usually smooth ; these granulations when worn, as they usually are at the apices, leave small foramina.

L. Ellerii.

Cells large, oblique, distinct ; surface cribriform ; lower lip thickened and produced into a variable number of processes ; frequently a median triangular one, and several smaller at the sides ; in some cells the median projection has a small avicularium on one side. Ovicell broad, granular above.

Frequent on algæ and shells.

L. cheilodon.

Cells small, oval, separated by narrow raised lines ; surface granular, usually with a row of small areolations along the margin ; mouth rounded or arched ; lip thickened, and with a broad denticle inferiorly. Ovicell globular, granular.

Williamstown, on shell.

L. schizostoma.

Cells elongated, distinct, arranged in lines ; surface granular, granulations usually larger and closer about the middle of the cell ; mouth semicircular above, lower lip straight, with a deep narrow slit in the middle. Ovicell large, granular.

Williamstown, on shell.

L. marsupium.

Cells small, distinct, arranged in longitudinal lines; upper part, immediately below the lower lip, forming a large rounded pouchlike projection; mouth with several small spines on the upper margin. Ovicell small, globular.

On shell.

Family CELLEPORIDÆ.

Genus CELLEPORA, *Fabricius.*

C. costata.

Cells very irregular, prominent; mouth surrounded by a variable number of thick processes, each bearing an avicularium on its internal surface; processes and cells ribbed. Ovicell small, globular.

Wilson's Promontory and Queenscliff, on zoophytes.

This very distinct and beautiful species occurs in small masses adhering to polyzoa and zoophytes. The cells are prominent; the mouth is arched above, with a deep wide notch in the lower lip, and is surrounded by a variable number of thick processes. In some very prominent cells these are scarcely apparent, the whole thick rim being occupied by the rounded ends of the ribs; in others there are one, two, three or even more prominent thick processes, on the inner surface of each of which is a small avicularium. These processes and the more prominent cells are beautifully fluted longitudinally. The ovicell is small, globular, and smooth, or with a sculptured area in front.

C. platalea.

Cells small, very irregular; mouth very irregular, sometimes with a large rostrum at one side, sometimes with a small one also. Numerous avicularia scattered irregularly over the polyzoary, mandible very long, spoon-shaped. Ovicell rounded, partly immersed, marked with radiating lines.

Queenscliff, on algæ.

A small species allied to *C. exigua.* The cells are very irregular; and the mouth varies greatly; sometimes no rostrum can be made out, at other times there are one or two. It may be recognised by the numerous scattered avicularia with the very long mandible resembling that of *Eschara platalea* or the bill of the spoonbill, and by the small ovicell marked with radiating lines.

C. variolosa.

Cells immersed, confused, indistinct; surface tubercular; mouth large, arched above, with a wide shallow notch below; rostrum large placed irregularly, at a little distance from the mouth of the cell, with a large avicularium on one side. Ovicell large, conical at the summit, areolated.

Queenscliff, on algæ.

A peculiar species, occurring as a thick layer encrusting a narrow, dark sea-weed. The cells are quite coalescent and indistinct, and the whole surface, in fresh portions, is tubercular or, in older cells, deeply areolated or pierced by round openings with smooth edges. These apertures are caused, as occurs also in other polyzoa, by the abrasion of the tubercles. The ovicells are very large, prominent at the summit, which is produced into a conical eminence; the surface is areolated like that of the cells.

C. intermedia.

Cells large, confused, oblique or nearly horizontal, faintly granular; mouth arched above, straight below; usually no distinct rostrum; the cell is prominent below the mouth towards the middle. Avicularia either small and situated on a small rostrum below the mouth, or placed irregularly, with a large spoon shaped mandible. Ovicell small, globular, partly immersed, faintly granular.

Queenscliff.

Of this I have only seen a single specimen. It is in a calcareous stony layer, more than an inch in diameter, attached to the root of a Laminaria and free at its edges. The cells are large, and a good deal resemble those of a *Lepralia*. They are heaped together irregularly, prominent below the mouth towards the middle. In a few of the cells there is a small elevation, an abortive rostrum, immediately below the mouth, with a conspicuous avicularium on its side. There are also one or two avicularia, irregularly situated, with large, long, broad, spoon-shaped mandibles.

Family ESCHARIDÆ.

Genus ESCHARA, *Ray.*

E. obliqua.

Polyzoary expanded, foliaceous; cells obliquely rhomboidal, separated by narrow, raised, smooth lines; surface, tubercular; mouth arched above, with a wide notch below.

Ovicell large, tubercular, traversed by irregular lines like those separating the cells.

Snapper Point, a single specimen.

The shape and arrangement of the cells is such that they form series running in an arched direction laterally.

E. elegans.

Polyzoary expanded, foliaceous, convoluted; cells quadrate, separated by narrow raised lines and arranged in longitudinal linear series; surface granular; mouth arched above, lower lip arched upwards and projecting, a minute curved denticle sometimes on each side of the mouth immediately above the angles. Avicularia, when present, situated at the side of the mouth. Ovicell large, granular, with lines on the surface similar to those separating the cells.

Queenscliff and Portland Bay.

E. dispar.

Polyzoary dividing into branching lobes; cells immersed; mouth spout-like superiorly. An avicularium on one side of the mouth, mandible pointed upwards.

Queenscliff, a single specimen attached to the root of a Laminaria.

E. denticulata.

Polyzoary thin, foliaceous, convoluted; cells quincuncial, wide above, contracted below, separated by narrow, smooth, or minutely crenulated margins; front depressed, granular, with an elongated slit-like opening on either side.

Snapper Point.

The front of the cell is depressed, sloping from the edges; the mouth opening is very large, arched above, straight below; the perforations in the sides are about one-third the length of the cells, the inner margin has a series of sharp denticles, the outer is granular like the rest of the cell. When fresh, the slit-like openings are obscured by the epidermis.

Genus BIFLUSTRA, *D'Orbigny.*

B. fragilis.

Polyzoary much convoluted, thin, brittle, semitransparent; cells quadrate, arched above, aperture partially filled in by a calcareous plate, leaving an oval or elliptical opening; lower margin entire.

King's Island and Port Curtis.

The specimens from King's Island and Port Curtis differ in several respects and perhaps ought to be considered as distinct species. In both, the polyzoary is very much convoluted, thin, cavernous and very brittle. In those from Port Curtis the convolutions are closer, the cells are nearly square, the raised margins separating them thick and strongly crenulated, the calcareous lamina thicker and more granular, and the edge of the oval opening thick and crenulated. In the King's Island specimens, the interstices of the convolutions are narrower; the cells are much more elongated, the raised margins separating them are thin and smooth, the calcareous laminæ very finely granular, and the edges of the elliptical opening smooth and very little or not at all thickened.

This seems to be the species described as *Eschara chartacea* by Lamarck. It may, especially the Port Curtis variety, be identical with the *B. delicatula* described by Busk as occurring recent in Australia, and fossil in the Coralline Crag. From this it differs in the absence of the serrated denticle described and figured as occurring in both recent and fossil specimens, and in the greater extent of, the lamina.

DICTYOPORA, *New Genus.*

Polyzoary erect, rigid, expanded, reticulate, attached by a flexible stem. Cells opening on both sides.

Dictyopora differs from *Retepora* and *Petralia* in having the cells opening on both sides, and from *Eschara* in being fenestrated and attached to a flexible stem.

The genus *Adeona* of Lamouroux contains two species *A. grisea* and *A. foliifera*, differing chiefly in the former being fenestrated, and the latter entire. *A. grisea* ought probably to be referred to the present genus.

D. cellulosa.

Polyzoary expanded, cavernous; fenestræ round, small, much narower than the interspaces. Cells distinct; mouth nearly circular. A large avicularium on the front of each cell below the mouth, mandible pointed obliquely upwards and outwards.

Queenscliff.

Of this species I have two specimens which were drawn up on a fishing line. The larger is nine inches high, and at its thickest part sixteen inches in circumference. The polyzoary forms an expanded lamina twisted and united, so as to form large cavernous compartments, mostly extending

from the circumference to the base; these compartments vary at their widest parts from one to three inches. The flexible stem is two inches high, an inch and a-half in diameter immediately above the root, and almost an inch at its junction with the rigid polyzoary; it is rough and irregularly transversely annulated. There are no ridges or prolongations of the stem on any part of the polyzoary.

Genus RETEPORA, *Imperato.*

R. porcellana.

Polyzoary expanded, waved or convoluted, thick; fenestræ elongated, about as wide as the subcylindrical interspaces. Cells oval or rhomboidal, smooth. An avicularium towards the middle of a cell, mandible short, generally directed vertically or nearly so, sometimes obliquely; occasionally there is also an avicularium placed obliquely on or below the lower lip. Dorsal surface vibicate.

This is distinguished from all the other Victorian species which I have seen by the size of the fenestræ which are as wide as the interspaces, and by the interspaces being thick and subcylindrical.

R. granulata.

Polyzoary thick, expanded, foliaceous, convoluted; fenestræ small, short, oval, not so wide as the interspaces. Cells ovate, whole surface granular. Ovicell immersed, granular. Dorsal surface faintly vibicate.

This species may at once be distinguished from the last by the different form and size of the fenestræ, which are much smaller and rounded. The whole surface is finely granular, and the granulations give to the edges of the fenestræ a crenulated appearance.

R. fissa.

Polyzoary expanded, foliaceous; fenestræ round or slightly elongated, about the same width as the interspaces. Cells ovate, separated by narrow raised lines, with an avicularium towards the centre, the mandible directed downwards and outwards. Ovicell globular, smooth, with a slit in front. Dorsal surface vibicate.

In this species the polyzoary is much thinner than in the other two here described, and the fenestræ which are small are of about the same width as the interspaces. From *R. monilifera* it is at once distinguished by the difference in the ovicell.

PETRALIA, *New Genus.*

Polyzoary erect, expanded, stony, reticulate, formed of a single layer of cells, placed horizontally side by side, and distinct through the whole thickness of the polyzoary.

The only other genus of Escharidæ, with a reticulate polyzoary, the cells of which are arranged in one plane, is *Retepora*. The arrangement of the cells is very different in the two genera. In *Retepora* they are oblique, and rest on a common calcareous base, while in *Petralia* there is no such basis, but each cell is as distinct on the back of the polyzoary as in the front.

P. undata.

Fenestræ elliptical; a large avicularium at the base of each in front. Cells quadrate, expanded above, slightly narrowed at the middle and below, separated by narrow raised lines; front areolated; mouth circular, with a short, broad, transverse avicularium immediately below the lower lip; behind, the cells are quadrate, deeply areolated, and separated by deep channels, at the bottom of which is a narrow elevated ridge. Ovicell large, granular; frequently one or two immovable processes surmounted by sessile avicularia rise from various parts of the ovicell, and there is generally one on each side of the mouth of the cell above which the ovicell is situated.

Queenscliff; Portland, Miss F. Birkett.

Family CRISIIDÆ.

Genus CRISIA, *Lamouroux.*

C. setosa.

Cells 6–10 in an internode, closely adnate, upper extremity usually free for a very small extent; mouth circular, entire; cell prolonged outside the mouth, into a stout projection to which is articulated a long hollow calcareous spine. Surface finely and minutely granular. Branches usually given off between the first and second pairs of cells in an internode. Joints brown.

A small species, parasitic on algæ and zoophytes.

C. biciliata.

Cells two in an internode; outer extremity free for a short distance; mouth circular; from the outside of each cell arise two long, hollow, jointed, filiform processes. Surface granular. Joints of polyzoary and cilia light brown or white.

Williamstown, Mr. Maplestone.

Another two-celled species occurs here, identical with that described and figured as *Crisidia Edwardsiana*, by D'Orbigny.* The present species is at once distinguished by the presence of two long, jointed cilia on each cell, there being but one in the former. In *C. Edwardsiana* also, the cells are much more produced, and the cilia are situated much further down the back of the cells. Another point of distinction, though not of much value, is that the joints are black in *C. Edwardsiana*, and light brown or the same colour as the cells in *C. biciliata*.

Family IDMONEIDÆ.

Genus HORNERA, *Lamouroux.*

H. foliacea.

Polyzoary reticulate, expanded, foliaceous, convoluted; branches subcylindrical; fenestræ large, oval or quadrate; openings of cells circular, exserted, margin divided into several sharp teeth; interstices finely granular; dorsal surface sulcate and granular.

Portland Bay; Wilson's Promontory; Tasmania.

This very beautiful species forms an expanded, foliaceous polyzoary flabelliform in young specimens, expanded and convoluted in those of older growth. The largest specimens attain a height of one or two inches. The fenestræ are large, generally quadrate, oval, or elliptical, broader than the subcylindrical branches. The form of the cell varies according to age. In a young small flabelliform specimen, the central cells have several serrations, the serratures of the lateral cells are very long and sharp, more especially at the outer edge which is produced. In older specimens, the serratures of the cells become worn off, so that the central ones appear to have the mouth scarcely if at all exserted and entire, while the lateral (those projecting on the edges of the fenestræ) have the outer lip produced, smooth, or slightly jagged. The depth of the posterior sulci and the prominence of the anterior ridges, as well as the distinctness of the granulations vary a good deal.

This is possibly the species alluded to by Busk, under the provisional name of *H. Gouldiana*, as having been brought from South Australia.

* Voyage; Zoologie, Zoophytes, 8, t. I. 4—8.

LIST OF VICTORIAN POLYZOA.

Class—POLYZOA.

Order I. PHYLACTOLÆMATA, *Allman.*

Suborder I. LOPHOPEA, Allman.

Family 1. PLUMATELLIDÆ.

Genus 1. Plumatella, *Lamarck.*

1. P. Aplinii, *McG.*

Genus 2. Fredericella, *Gervais.*

1. F. —— *sp.**

Order II. GYMNOLÆMATA, *Allman.*

Suborder I. CHEILOSTOMATA, Busk.

Family 1. CATENICELLIDÆ.

Genus 1. Catenicella, *Blainville.*

1. C. lorica, *Busk.*
2. C. ventricosa, *Busk.*
3. C. hastata, *Busk.*
4. C. alata, *Thomson.*
5. C. plagiostoma, *Busk.*
6. C. intermedia, *McG.*
7. C. cribraria, *Busk.*
8. C. rufa, *McG.*
9. C. margaritacea, *Busk.*
10. C. formosa, *Busk.*
11. C. Hannafordi, *McG.*
12. C. perforata, *Busk.*
13. C. elegans, *Busk.*
14. C. Dawsoni, *Thomson.*
15. C. Buskii, *Thomson.*
16. C. cornuta, *Busk.*
17. C. crystallina, *Thomson.*
18. C. carinata, *Busk.*
19. C. aurita, *Busk.*
20. C. geminata, *Thomson.*

* A species of Fredericella was found by Mr. Aplin some years ago in a creek at Muckleford, near Castlemaine. It has not yet been described.

Family 2. CELLULARIIDÆ.

Genus 1. Cellularia, *Pallas.*
1. C. cuspidata, *Busk.*

Genus 2. Scrupocellaria, *Van Beneden.*
1. S. scrupea, *Busk.*
2. S. cervicornis, *Busk.*
3. S. ornithorhynchus, *Thomson.*
4. S. cyclostoma, *Busk.*

Genus 3. Emma, *Gray.*
1. E. cyathus, *Thomson sp.*
2. E. crystallina, *Gray.*
3. E. cervicornis, *McG.*
4. E. tricellata, *Busk.*
5. E. Buskii, *Thomson sp.*

Genus 4. Canda, *Lamouroux.*
1. C. arachnoides, *Lamx.*

Family 3. SALICORNARIIDÆ.

Genus 1. Salicornaria, *Cuvier.*
1. S. hirsuta, *McG.*
2. S. gracilis, *Busk.*
3. S. tenuirostris, *Busk.*

Genus 2. Nellia, *Busk.*
1. N. oculata, *Busk.*

Genus 3. Onchopora, *Busk.*
1. O. hirsuta, *Busk.*

Family 4. SCRUPARIIDÆ.

Genus 1. Scruparia. *Oken.*
1. S. chelata, *L. sp.*

Family 5. CABEREIDÆ.

Genus 1. Caberea, *Lamouroux.*
1. C. rudis, *Busk.*
2. C. Boryi, *Audouin.*
3. C. lata, *Busk.*

Family 6. BICELLARIIDÆ

Genus 1. Bicellaria, *Blainville.*
1. B. grandis, *Busk.*
2. B. gracilis, *Busk.*
3. B. tuba, *Busk.*
4. B. turbinata, *McG.*

Genus 2. Halophila, *Gray.*
1. H. Johnstoniæ, *Gray.*

Genus 3. Bugula, *Oken.*
1. B. neritina, *L. sp.*
2. B. robusta, *McG.*
3. B. dentata. *Lamx sp.*
4. B. cucullata, *Busk.*
5. B. avicularia ? *Pall sp.*

Family 7. FLUSTRIDÆ.

Genus 1. Flustra, *L.*
1. F. denticulata, *Busk.*

Genus 2. Carbasea, *Gray.*
1. C. episcopalis, *Busk.*
2. C. indivisa, *Busk.*
var. cyathiformis, *McG.*
3. C. pisciformis, *Busk.*
4. C. dissimilis, *Busk.*
5. C. elegans, *Busk.*

Genus 3. Diachoris, *Busk.*
1. D. spinigera, *McG.*
2. D. Magellanica, *Busk.*

Genus 4. Spiralaria, *Busk.*
1. S. florea, *Busk.*

Family 8. FARCIMINARIIDÆ.

Genus 1. Farciminaria, *Busk.*
1. F. dichotoma, *V. Suhr. sp.*

Family 9. GEMELLARIIDÆ

Genus 1. Dimetopia, *Busk.*
1. D. spicata, *Busk.*
2. D. cornuta, *Busk.*

Genus 2. Calwellia, *Thomson.*
1. C. bicornis, *Thomson.*

Genus 3. Didymia, *Busk.*
1. D. simplex, *Busk.*

Family 10. HIPPOTHOIDÆ.

Genus 1. Hippothoa, *Lamouroux.*
1. H. crassa, *McG.*
2. H. catenularia, *Jameson, sp.*
3. H. divaricata, *Lamx.*
4. H. distans, *McG.*

Genus 2. Alysidota, *Busk.*
1. A. ciliata, *McG.*

Genus 3. Ætea, *Lamouroux.*
1. A. anguina, *L. sp.*
2. A. dilatata, *Busk.*

Family 11. MEMBRANIPORIDÆ.

Genus 1. Membranipora, *Johnston.*
1. M. membranacea, *L. sp.*
2. M. pilosa, *L. sp,*
3. M. umbonata, *Busk.*
4. M. mamillaris, *McG.*
5. M. cervicornis, *Busk.*
6. M. perforata, *McG.*
7. M. Lacroixii, *Savigny.*
8. M. Woodsii, *McG.*
9. M. dispar, *McG.*
10. M. lineata, *L. sp.*
11. M. ciliata, *McG.*
12. M. serrata, *McG.*
13. M. armata, *McG.*
14. M. falcata, *McG.*

Genus 2. Lepralia, *Johnston.*
1. L. vittata, *McG.*
2. L. Brogniartii, *Audouin.*
3. L. mucronata, *McG.*
4. L. ferox, *McG.*
5. L. diadema, *McG.*
6. L. canaliculata, *McG.*
7. L. trifolium, *McG.*
8. L. lunata, *McG.*
9. L. larvalis, *McG.*
10. L. monoceros, *McG.*
11. L. ciliata, *L. sp.*
12. L. excavata, *McG.*
13. L. Malusii, *Audouin, sp.*
candida, *McG.*
14. L. circinata, *McG.*
15. L. Ellerii, *McG.*
16. L. papillifera, *McG.*
17. L. megasoma, *McG.*
18. L. pertusa, *Esper.*
19. L. elegans, *McG.*

20. L. marsupium, *McG.*
21. L. cheilodon, *McG.*
22. L. schizostoma, *McG.*
23. L. hyalina, *L. sp.*
24. L. crystallina, *McG.*

Family 12. CELLEPORIDÆ.

Genus 1. Cellepora, *Fabricius.*
1. C. pumicosa, *L. sp.*
2. C. fusca, *Busk.*
3. C. alata, *Lamk.*
4. C. mamillata, *Busk.*
5. C. exigua, *McG.*
6. C. platalea, *McG.*
7. C. costata, *McG.*
8. C. variolosa, *McG.*
9. C. intermedia, *McG.*
10. C bispinata, *Busk.*

Family 13. ESCHARIDÆ.

Genus 1. Eschara, *Ray.*
1. E. obliqua, *McG.*
2. E. elegans, *McG.*
3. E. platalea, *Busk.*
4. E. lichenoides, *Milne Edwards.*
5. E. decussata, *Milne Edwards.*
6. E. dispar, *McG.*
7. E. denticulata, *McG.*

Genus 2. Biflustra, *D'Orbigny.*
1. B. delicatula? *Busk.*
2. B. fragilis, *McG.*

Genus 3. Petralia, *McG.*
1. P. undata, *McG.*

Genus 4. Retepora, *Imperato.*
1. R. cellulosa? *Lamouroux.*
2. R. monilifera, *McG.*
3. R. porcellana, *McG.*
4. R. fissa, *McG.*
5. R. granulata, *McG.*
6. R. phœnicea, *Busk.*

Genus 5. Dictyopora, *McG.*
1. D. cellulosa, *McG.*

Suborder II. CYCLOSTOMATA, Busk.

Family 1. CRISIIDÆ.
Genus 1. Crisia, *Lamouroux.*
1. C. acropora, *Busk.*
2. C. setosa, *McG.*
3. C. Edwardsiana, *D'Orbigny.*
4. C. biciliata, *McG.*

Family 2. IDMONEIDÆ.
Genus 1. Hornera, *Lamouroux.*
1. H. foliacea, *McG.*
Genus 2. Idmonea, *Lamouroux.*
1. I. radians, *Milne Edwards.*

Family 3. DIASTOPORIDÆ.
Genus 1. Discoporella, *Gray.*
1. D. hispida, *Johnston, sp.*

Suborder III. CTENOSTOMATA, Busk.

Family 1. SERIALARIIDÆ.
Genus 1. Serialaria, *Lamarck.*
1. S. cornuta, *Lamx, sp.*
2. S. crispa, *Lamarck.*

ART. XXII.—*A Sketch of a New Theory of the Oceanic Tides, based upon examination of the causes assigned to exceptional "tidal" waves.* By MR. J. WOOD BEILBY.

[Read by Mr. Rawlings, 26th November, 1868.]

In this paper Mr. Beilby sought to demonstrate that the earth's surface was liable to regular changes by the relative elevation or depression of areas of sea surface in the northern and southern hemispheres, disproportionately, as ascertained by barometrical observations, and that redundance of matter thus unequally accumulated with excessive local precipitation and congelation in areas within polar regions, must tend to alter the symmetrical figure, and hence the centre of gravity and axis of rotation of a spheriod poised in space, and relatively change the position of her equator with reference to the plane of her orbit; thus accomplishing by terrestial agencies, results hitherto ascribed to lunar and solar gravitation.

PROCEEDINGS.

1868.

PROCEEDINGS.

ROYAL SOCIETY OF VICTORIA.

ANNUAL MEETING.

13th January, 1868.

The President, R. L. J. Ellery, Esq., in the chair.

The Hon. Secretary (Mr. Thos. H. Rawlings) read the following Report of the Council for the year 1867 :—

"The Council, in submitting its report for the year 1867, has much "pleasure in offering to the members its congratulations on the result "of the past session.

"The presence of His Royal Highness Prince Alfred in the colony, "afforded the Council, towards the termination of the year, an "opportunity of presenting in the name of the Society, an address of "congratulation, together with a copy of the Transactions, suitably "bound ; both of which His Royal Highness was graciously pleased "to accept, and the reply thereto will be read to the Society.

"The Council regret, however, that the Society, representing as it "does science in Victoria, and being the oldest of the Royal Societies "in the Australian Colonies, should have been utterly ignored by the "Reception Committee in all its arrangements, a course of action "contrasting so invidiously with the custom adopted in England and "elsewhere, towards scientific bodies.

"On the 4th March, the Annual Conversazione of the Society was "held. His Excellency, Sir J. H. T. Manners Sutton, the patron of "the Society, presiding, when the customary annual address of the "President was delivered, and other papers read.

"On the 10th June, Mr. J. Cosmo Newbery was elected a member "of Council, in place of Mr. T. E. Rawlinson, an old and valued "member of the Society, who has removed to the Western District.

"The ordinary work of the session has far exceeded that of late "years. Twelve ordinary meetings have been held ; (the first meeting, "in January was, however, solely occupied with the reception of the "Report, Balance-sheet, and election of officers) at which nineteen "papers were read, and in enumerating them in the order submitted "to the members, the Council congratulate the Society that, from

" the importance of the papers, in a scientific point of view, the Royal " Society of Victoria has advanced in the position it holds among the " learned societies of the world.

1867.		
" Feb. 11.	Professor M'Coy.	On three New Species of Victorian Birds.
" ,, ,,	Do.	Notes on the discovery of Enalio Saurian " and other Cretaceous Fossils.
" ,, ,,	Mr. G. W. Groves.	On a Contribution to Meteorology.
" April 8.	Mr. J. C. Newbery.	On the Manufacture of Paper from Native " Plants.
" May 13.	Rev. Dr. Bleasdale.	On Colonial Wines.
" ,, ,,	Dr. Mueller.	On New Coleoptera, by Count de Castel- " nau.
" June 10.	Professor Halford.	On the appearance of Blood after death " from Snake-bite and Cholera.
" July 8.	Mr. Rawlings.	On the Bone Cave of Glenorchy, Tas- "mania. Communicated by Mr. Wintle, " Hobart Town.
" ,, ,,	Rev. Dr. Bleasdale.	Notes on a New Victorian Gem. The " Rubellite.
" Aug. 12.	Mr. H. C. Thompson.	On the Formation of Mineral Veins and " the deposit of Metallic Ore in them.
" Sept. 9.	Mr. H. K. Rusden.	On the Ethics of Opinion.
" ,, ,,	Professor M'Coy.	On the Character and Species of Wombats.
" Oct. 14.	Professor Halford.	Further Observations on Death by Snake- " bite, with Microscopical demonstra- " tions.
" ,, ,,	Mr. Thos. Harrison.	Notes on the Rev. J. E. T. Wood's paper " 'On the Glacial Epoch of Australia.' " Communicated by Mr. J. Haast, " Christchurch.
" ,, ,,	Mr. J. C. Newbery.	On the Mineral Waters of Victoria.
"Nov. 11.	Professor Halford.	On a discovery for determining danger of " Collision in Vessels crossing one " another's track. Communicated by " Captain Perry.
" ,, ,,	Dr. J. E. Neild.	On the Purification of Water. Commu- " nicated by Mr. J. G. M. Dahlke.
" Dec. 9.	The President.	On a New Self-Registering Electrometer
" ,, ,,	Mr. J. C. Newbery.	Report on a Filter recommended by Mr. " Dahlke.

" With reference to Professor Halford's paper on Snake-bite, the " Council, considering the subject of animal poisoning one of so much " importance, not only to the Australian Colonies, but to the whole " civilized world, made a grant from the funds of the Society, to assist " Professor Halford in proceeding with his investigations, and brought " the entire subject under the notice of the Chief Secretary.

" The value of the paper communicated by Captain Perry has not " been overlooked, and the Council has taken action with a view of " impressing upon the Board of Navigation the necessity of a thorough " inquiry into the matter.

" The Council believe the Society will derive credit from its thus " endeavouring to draw public attention to subjects of a highly useful " and important character, and therefore cannot help regretting that " the various sections as provided for by Law 60, have not met with " support from the general body of members.

" The Council are of opinion the interests of the Society would be " also materially advanced, if the Ordinary Meetings could take place " twice in a month, as scientific discoverers would thus be afforded a " better opportunity of placing their papers more readily before the " public. The position of the Royal Society would be also one of " greater importance, as it would enable the Council to issue quarterly " parts of the Transactions, while at the present time the cost of " printing and the labour of revising, renders a quarterly periodical, " containing not more than three or four papers, a heavy burden, " without offering an adequate return. If the members are desirous " that such alterations in the Ordinary Meetings should be made, and " which will of course entail a very large additional amount of work " on the Executive, their wishes should be now signified ; but the " Council urge upon members the necessity of carrying out such a " motion by contributions of papers, which during the past year have " emanated but from very few members of the Society.

" In May, Part I. of Vol. VIII. of the Transactions was issued and " forwarded to the members, honorary members, and the learned " societies with which the Royal Society is in correspondence the " second part of the volume is now ready for issue, bringing the papers " and proceedings up to the close of the year 1867. The Council " appeal with confidence to the general body of members that the " labour necessarily incurred by these publications will be appreciated, " and trust the future Executive will be enabled to prevent the " Transactions ever again falling into arrear.

" During the Session twelve new members were elected. The " Council, however, regret having had to remove four names from the " roll of membership for non-payment of subscription, but it feels " some pleasure in stating that after a careful revision of the list, there " appears little necessity for having recourse to such a proceeding in " the coming year.

" By the Balance-sheet, duly audited by Messrs. Blackburn and " Zumstein, it will be seen that the balance at the credit of the " Society is £30 19s. 7d. The assets and liabilities are also appended.

" A grant of £100, to assist in defraying the expenses of publishing " the Transactions has been kindly placed on the estimates by the Hon. " the Treasurer, who has ever taken an interest in the Royal Society, " and which aid, considering the large number of volumes distributed " gratuitously abroad, the Council believe the Society fairly entitled " to. Unfortunately that amount has not yet been received, but " taking it as a good asset, it places the Royal Society in a financial " position which for years it has not witnessed. The Council call the

" attention of members to the great economy with which the Society " has been worked during the past year, enabling the extra charges for " the Sessson to be defrayed from the ordinary revenue.

" A catalogue of the books and pamphlets has been prepared by " the Honorary Librarian, showing that the Library has been aug- " mented by 137 publications. This catalogue, together with a report " from the Honorary Curator, has been bound up in the last part of " Vol. VIII., just issued.

" During the year, the grant for the block of land on which the hall " stands has been applied for in the names of Sir William Stawell, " the Rev. Dr. Bleasdale, and Messrs. Ellery and Ligar, as Trustees of " the Society.

" It will be necessary, during the forthcoming session, to take into " consideration the state of the hall, and in referring that subject to " the Council for 1868, attention should be drawn to the want of " various offices for the conduct of business, and the position of the " building should also be referred to them.

" The President, Vice-President, Secretary, Treasurer, Librarian, " Curator, and Messrs. Aplin, Gillbee, M'Gowan, Rusden, Von " Guerard and Professor Halford, members of Council, retire by " rotation. Vacancies caused by the non-attendance of Professor " M'Coy, Dr. Barker, and Mr. G. S. Lang have also to be filled up, " and the names of the various candidates have already been duly " forwarded to each member. The election will take place imme- " diately after the discussion on the report.

" An alteration in Law 7, changing the night of meeting will also " be submitted for your consideration.

" The Council, in closing its report for 1867, trust the ensuing " session will be as progressive as the past, and hope the members " will consider it their duty to lend vigorous aid in furthering the " objects for which the Society was formed. Nearly every mail from " Europe brings requests from societies to be placed in possession of " the Transactions, and it therefore behoves those who seek to uphold " the permanent interests of Victoria, to keep the Royal Society " foremost in the cultivation of Science, Literature, and Art."

Dr. *The Hon. Treasurer in Account with the Royal Society of Victoria.* Cr.

1867.					£	s.	d.
Jan. 1.	To Balance				39	0	0
Dec. 31.	Subscriptions to date—						
	63 Yearly	£132	6	0			
	1 Half-yearly	1	1	0			
	2 Country Members	2	2	0			
	12 Entrance Fees New Members	25	4	0			
	1 yearly, 1866	2	2	0			
	1 Half-yearly, 1866	1	1	0			
					163	16	0
	Interest on Deposit Account				16	16	2
					£219	12	2
	To Balance brought down				£30	19	7

1867.					£	s.	d.
Feb. 5.	By Gas account, 1866				4	5	6
March	Conversazione account				27	3	0
Nov. 20.	Grant to Professor Halford for Experimental Purposes				5	0	0
Dec. 31.	Sundry Payments during the year—						
	Printing, Binding, &c.				85	4	0
	Insurance on Building				5	0	0
	Flags for Illuminations and expenses thereon				12	17	6
	Commisssion on Subscriptions, paid Collector				15	19	3
	Advertising				7	17	0
	General Charges—						
	Messenger	£10	0	0			
	Postages, Incidentals, Stationery, &c. ..	15	6	4			
					25	6	4
	Balance—						
	Bank	£24	12	1			
	Secretary	6	6	6			
					30	19	7
					£219	12	2

Audited and found correct,

Signed) JAMES BLACKBURN.
H. ZUMSTEIN.

13*th January*, 1868.

Reply of His Royal Highness Prince Alfred to the Address presented on the 26th November.

"To the President and Members of the Royal Society of "Victoria.

"Gentlemen,—

"I have received the address of the Royal Society "of Victoria with much satisfaction, and I thank you for the "expressions of gratification at my arrival in this Colony.

"The description you give me of the objects and scope of your "Society, including as it does the very important branch of scientific "study to which you refer, convinces me of the beneficial nature of "your institution, and I sincerely trust you may always share with "the Mother Country the benefit that will follow from her energy "in the pursuit of Science, and upon the general spread of the "knowledge of all those studies which your Society fosters.

"I cordially concur with you in hoping that my visit to this part "of the Empire may conduce to the increased unity and solidity of "our national position, and I also trust that a concentration of all "interests connected with Science, Literature, and Art, may be "promoted by the increased acquaintance with this flourishing "Colony which may result from my presence among you.

"(Signed) Alfred."

Some discussion arose on the paragraph referring to fortnightly meetings, in which Messrs. Gillbee, Butters, Professor Halford, Dr. Barker, and Mr. Rawlings took part. Ultimately the whole subject was left for the consideration of the Council, and on the proposition of Dr. Barker, seconded by Mr. A. K. Smith, the Report and audited Balance-sheet was adopted.

Messrs. Thomas Reed and Joseph Bosisto were appointed Scrutineers for the evening.

A ballot took place for Mr. George Manns, as an ordinary member, and that gentleman was declared duly elected.

Dr. Neild moved an alteration in Law 7, by omitting the words "second Monday," and substituting in place thereof "second Thursday." Mr. H. A. Thompson seconded the proposition, which, after some discussion, was put to the meeting and lost.

The ballot for the various vacant honorary offices took place.

President :

R. L. J. Ellery, Esq.

Vice-Presidents :

A. K. Smith, Esq. Professor Halford.

Secretary :

T. H. Rawlings, Esq.

Treasurer :
Robt. Willan, Esq.

Librarian :
James E. Neild, Esq., M.D.

Curator :
Thos. Harrison, Esq.

Members of Council :

Dr. Barker.
W. Gillbee, Esq.
C. W. Ligar, Esq.
Prefessor M'Coy.
S. W. M'Gowan, Esq.
H. K. Rusden, Esq.
Professor W. P. Wilson.
W. Walker, Esq.
Edward Wild, Esq.

Were declared duly elected, and with Messrs. J. B. Were, H. A Thompson, and J. C. Newbery, whose term of office had not expired, form the Executive for 1868.

(Signed) Robt. L. J. Ellery.

10th February, 1868.

Ordinary Meeting.

Monday, 10*th February*, 1868.

The President, R. L. J. Ellery, Esq., in the chair.

Mr. W. Sydney Gibbons, who had been proposed and seconded as a candidate for ordinary membership, was balloted for and declared duly elected.

The following contributions were acknowledged :—"Transactions of the Royal Academy of Science, Munich," 1866, Vol. II., parts 2, 3, 4. 1867, Vol. III., parts 1, 2, 3. "Rules of the Academy." "Abhandlungen der Mathematisch," Physikalischen classe, Vol. X. "Ueber die Branchbarkeit," by Dr. Bischoff. "Fragmenta Phytographiæ Australiæ," No. XLIII., by Dr. Mueller. "Journal of the Royal Society, Dublin," No. 36. "Observations on the Crust of the Earth, and on Gold-bearing Rocks," by Richard Capper.

(Signed) Robt. L. J. Ellery.

24th February, 1868.

Ordinary Meeting.

Monday, 24*th February*, 1868.

The President, R. L. J. Ellery, Esq., in the chair.

The following publications were acknowledged :—"Transactions Botanical Society, Edinburgh," Vol. IX., part 1. "Report Royal Geographical Society, Copenhagen." "Results of Meteorological Observations, made under the direction of the United States Patent Office, and Smithsonian Institute," Vol. II., part 1. "Report of

the Smithsonian Institute," 1863. "Proceedings of the Portland Society of Natural History," Vol. I., part 1. "Journal of the Society." "Transactions Boston Society of Natural History," Vol. IX., No. 21. "Journal of the Society for the Culture of Science, Breslau," 1862-3-4. "Transactions Academiæ Cæsaraeœ Leopoldine Carolinæ Germanicæ Natural Curiosorum," Vol. 21. "Transactions of the Imperial Society of Naturalists, Moscow," No. 1, 1867.

The President read a paper "On the Temperature of Solar Radiation as measured by the Black Bulb Thermometer." (See part 1, Transactions).

Messrs. A. K. Smith, Gibbons, and Professor Halford spoke as to the temperature at different places, and as to any difference in measurement arising from the use of various coatings, to all of which the President, in reply, promised due inquiry should be made.

Mr. H. K. Rusden read a paper "On Moral Responsibility." (See part 1, Transactions).

(Signed) Robt. L. J. Ellery.

9th March, 1868.

Ordinary Meeting.

Monday, 9th March, 1868.

The President, R. L. J. Ellery, Esq., in the chair.

The Hon. Secretary announced that vacancies in the Council had occurred through the retirement of Messrs. J. B. Were and Wm. Walker.

It was resolved that these vacancies should be filled up at the next ordinary meeting.

Mr. John Blair, M.R.C.S.E., was proposed by Mr. Gillbee, and seconded by Mr. Ellery, as a candidate for ordinary membership; ballot to take place next meeting.

The following contributions to the Library were acknowledged:—"Fifteenth Annual Report of the Council of the City of Manchester on the Working of the Public Free Libraries." "Journal of the Statistical Society of London," Sept. 1867. "Transactions Institute Naval Architects," Vol. VII. "Transactions, Society for the Culture of Science and the Fine Arts, Bremen," April 1866 to March 1867. Transactions of the Imperial Society of Naturalists, Moscow," No. 1, 1867.

Professor Halford drew attention to a paragraph in the *Age* newspaper of that morning, and the Hon. Secretary explained that the objectionable matter had been inserted between the first and second paragraphs of a small notice he had prepared for the press, by those connected with the paper, without his knowledge and sanction, and that he had called at the office and remonstrated thereat.

Professor Halford described a pair of scissors he had caused to be made for the excision of Snake-bite. (See part 1, Transactions).

Professor Halford afterwards referred to the plan adopted by Professor Harvey of University College, who had made many experiments with poisoned animals, more especially with the puff adder. It was to mix thoroughly the arterial blood with 100 parts of air, and after 24 hours the following results were obtained :—

	From the blood of a healthy dog.	From the blood of a dog bitten by a puff adder.
Oxygen	19·700	17·09
Carbonic Acid ...	0·409	1·09
Nitrogen	79·891	81·82

The President stated that he had lately opened the veins in the leg of a dog bitten by a tiger snake and sent to him by Professor Halford, and after six hours had elapsed inspected the blood, which he then found in a perfectly normal healthy condition. A subsequent inspection enabled him to see a nebulous matter among the granules, and a number of peculiarly shaped cells containing one, two, three and four nuclei ; so large as he should think would prevent them being confounded with white corpuscles. After twenty hours he had again examined the blood and found the cells had increased ; the blood was full of crystals, and on applying magenta he found they coloured easily and were better seen. The next day the action of the magenta had caused the cells to appear as if they had burst.

Mr. Foord corroborated the statements of Mr. Ellery, with whom he had inspected the blood.

Dr. Ralph differed from the results arrived at by the President.

Mr. W. S. Gibbons had examined a dog bitten by a tiger snake and sent to him by Professor Halford. He recognized the cells and nuclei, the most of which were opaque, but could not discover the red crystals spoken of.

Mr. Gillbee called back the attention of members to the instrument placed before them that evening by Professor Halford, for as whatever was recommended by the Royal Society carried with it a certain value, he thought it as well that any objection raised should be plainly stated. He did not consider the scissors altogether suitable to the purposes for which they had been designed. The first thing in snake-bite was to excise the bitten part, and in doing that the main thing was to go beyond the fang without reference to the quantity of skin cut off. He did not think the instrument now shown was constructed to go deep enough, and if not, the public in using it would be misled. It was necessary to cut from a $\frac{1}{4}$ to $\frac{1}{2}$ an inch in depth to insure safety in any excision, and this, he believed could not be done with the scissors now shown. He freely admitted the ingenuity of the invention, but would certainly prefer to operate with a scalpel.

Professor Halford, in a general reply, referred to the observations of Messrs. Ellery and Foord, as carrying out his previously asserted theory. With regard to the objection taken to the pair of

scissors before them, he contended the instrument would cut deeper than the poisoned fang could possibly go. An improvement was no doubt possible, but as they were, he considered them highly useful to those liable from travel or otherwise to snake encounters, and it was for such a purpose he had got them constructed.

(Signed) Robt. L. J. Ellery.

March 26, 1868.

Ordinary Meeting.

Thursday, 26th March, 1868.

The President, R. L. J. Ellery, Esq., in the chair.

The following contributions to the library were acknowledged :— "Report on Leprosy," by the Royal College of Physicians; presented by the President of the Board of Health. "Fragmenta Phytographiæ Australiæ," part XLIV., presented by Dr. Mueller. "Journal of the Linnean Society," No. 38.

Captain Kay, R.N., and Thomas Higinbotham, Esq., C.E., were duly elected members of Council.

The president read a letter from the Private Secretary of the Governor, apologizing for the non-attendance of His Excellency.

The President delivered the annual address. (See part 1, Transactions).

(Signed) Robt. L. J. Ellery.

April 20, 1868.

Ordinary Meeting.

Monday, 20th April, 1868.

The President, R. L. J: Ellery, Esq., in the chair.

The following contributions to the library were acknowledged :— "War Department Circular," No. 5, being a report on Epidemic Cholera. "Journal of the Natural History Society of Hamburg," Nos. 4 and 5. "List of Donations to the Bodleian Library," 1867. "Transactions of the Royal Society," Nos. 64, 68, 69, 74. "Transactions of the Royal Geographical Society," Nos. 1 and 6, of Vol. X. "Transactions of the Royal Horticultural Society," No. 9, of Vol. I, new series. "Fragmenta Phytographiæ Australiæ," No. 45; by Dr. Mueller. "Papers on the Balancing of a Steam Saw;" "A Memoir of the late D. Elder, Esq.;" "A Rule for Calculating the Displacement of Ships;" "Transactions of the Institution of Engineers of Scotland;" "Description of some Tug Steamers for the Godavery River;" "Paper on the most Profitable Speed for a fully laden Cargo Steamer, for a given Voyage;" presented by J. R. Napier, Esq.

Mr. John Blair, M.R.C.S.E., was balloted for, and duly elected a member of the Society.

The President read a paper by Mr. J. D. Postle, C.E., "On the Application of Cold, resulting from the Expansion of Compressed Air, to the Preservation of Animal Food." (See part 1, Transactions).

Mr. T. Learmonth inquired in what way Mr. Postle's plan was superior to that of Mr. Kirk's, and whether it was applicable to large masses of meat ?

Mr. Postle said the principal disadvantage in Mr. Kirk's process was that in it the same air was used over and over again, while in his own a stream of fresh air was maintained.

The Rev. Dr. Bleasdale hoped that in Mr. Postle's process the mechanical difficulties were overcome, but even if so, the commercial obstacles to success were very great. He had had experience of frozen meat, and knew the objections of people in England to its use. There was greater expense in cooking it, and it required to be passed through boiling water several times before cooking could be commenced.

Mr. Napier heartily concurred in the practicability of the principle advocated by Mr. Postle, and indeed had recommended a similar process to the Indian Government for cooling rooms.

The Rev. Dr. Bleasdale thought the plan might be more advantageously adapted to the preservation of cooked meat.

Mr. Macredie said frozen meat in Canada presented no such obstacles to proper subsequent cooking as were anticipated by Dr. Bleasdale.

Professor M'Coy inquired whether Mr. Postle had made any estimate of the cost of his method as compared with that of refrigeration by means of ether, ammonia, and other means often used. Mr. Postle's plan appeared remarkably simple.

Mr. Postle thought the use of ammonia dangerous where brass, zinc, or perhaps iron vessels were used, as it had a strong tendency to make them very brittle, when explosions might result. He thought a loss was occasioned by the decomposition of the ammonia. He considered the cost of a satisfactory test of his process would cost about £250.

The President said the question seemed to have advanced as far as could be expected without actual experiment, and invited members to consider the advisability of adjourning the discussion.

The discussion was accordingly adjourned.

(Signed) Robt. L. J. Ellery.

April 30, 1868.

ORDINARY MEETING.

Thursday, 30th April, 1868.

The President, R. L. J. Ellery, Esq., in the chair.

The following contributions to the library were acknowledged:— "Annual Report of the American Secretary of War," 1866. "List of Reported Dangers in the Pacific Ocean." "Annual Report of the Board of Regents of the Smithsonian Institute," 1866. "Proceedings of the Boston Society of Natural History," 1866. "Condition and Doings of the Boston Society of Natural History," 1866. "Smithsonian Miscellaneous Collections," Vols. VI. and VII. "Memoirs read before the Boston Society of Natural History," Vol. I., parts 1 and 2. "Oversigt over det Kongelige Danske Videnskabernes Selskabs." "Abhandlungen der Schleischen Gesellschaft," 1865-6. "Jahres Bericht der Schleischen Gesellschaft." "Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt," No. 4, Vol. XV.; Vol. XVI., Nos. 2 and 3. "Mitthelungen der Kaiserlich-Königlichen, Geographischen Gesellschaft," Vol. VIII., part 2. "Catalogue Italian Exhibits, Dublin Exhibition," 1865. "Transactions Royal Academy Vienna," five parts.

Mr. J. Cosmo Newbery read a paper "On the formation of Gold Nuggets in Auriferous Drifts." (See part 1, Transactions).

The President adverted to a paper read before the Society by Mr. Charles Wilkinson and to be found in the published transactions, and eulogising Mr. Newbery's paper, inquired if any analysis of recent volcanic waters had been made, and if gold had been found therein?

Mr. Newbery thought not, although gold had been found in sea-water, and referred to some remarks by Dr. Percy on the examination of copper upon the bottoms of ships.

Mr. Bonwick inquired if gold had been found in Vesuvian minerals? Mr. Ulrich thought gold existed in meteoric waters. Mr. Newbery said gold in the neighbourhood of reefs was richer in standard than reef gold.

Mr. Crooke asked if a solution of gold had been found in the waters of this colony? Mr. Newbery said only by Mr. Daintree; but that might arise from want of examination. Mr. Crooke said Evan Hopkins had suggested a similar theory, and that the nuggets probably grew larger from attraction.

Messrs. W. S. Gibbons, Ulrich, Bonwick, and the President, joined in a short discussion, in which the value of the paper was dwelt on, and hope expressed that a further paper from Mr. Newbery would be soon presented to the Society.

The President drew attention to the adjourned debate on Mr. Postle's paper, stating that since the last meeting circumstances had arisen, rendering all discussion connected with entering upon any testing of the process premature. As to the general question of meat-preserving, he would mention that the use of paraffine had not

been alluded to at the previous meeting. That process had however been tried, by the dipping of meat in hot paraffine at a temperature of about 150 degrees; however a great obstacle to its employment was the liability of the paraffine to crack. Some years back he had made some small experiments by placing joints of meat in the ice-house on the banks of the Yarra. The first joint turned out bad, but the second and third tried were successful. He considered the failure with the first joint arose from allowing it to thaw gradually in the open air before cooking and so permitted of its being acted on by the floating germs of decomposition. The other joints were placed in hot water to thaw.

Mr. W. S. Gibbons approved of paraffine, and said that a Melbourne firm were trying a plan of packing meat closely and then running hot tallow over it before fastening the case. He said meat thawed in hot water would always eat flabby, and referred to the plan adopted by the Cunard Line of Steamers where the packets were victualled with meat cured and packed in ice.

Mr. Blair had seen, years back, in sailing from Scotland to the Arctic seas, meat preserved by being simply tied to the mast-head. It had then been sawn by the carpenter like a piece of red gum, but was perfectly sweet and tender. On the return voyage and as a warmer climate was approached the meat decayed.

Mr. Newbery said he had, in North America, seen venison frozen, but noticed that when thawed it decomposed quicker than fresh meat, caused, he thought, from the fact that the cells in the meat burst, as water pipes would when the liquid became frozen.

Mr. Postle said his plan would soon be tested, as an eminent capitalist had made up his mind to construct the necessary machinery. He then referred to what he considered were the defects in Mort's patent.

Mr. James Harrison said eleven years ago he was enabled to witness the process of freezing, by the condensation and expansion of air. The machinery was of a first-class character, driven by a 90 horse-power steam engine, and the air was cooled by water, nearly ice cold, taken from the Regent's Canal at Camden Town, where he had inspected it. Yet the result of three days working was only one hundred weight of ice. The fact was, the process itself was bad; theoretically the process ought to be a failure. A pound of air occupied a space of little more than 12½ cubic feet. The specific heat of air was only one-quarter that of water, so that it would require four pounds, or 50 cubic feet of air to heat or cool one pound of water to a mean temperature. If the air be cooled to say 10 degrees below the freezing point, it would require 700 cubic feet of air to abstract the 140 degrees of latent heat in the water before it would freeze. With a condensing cylinder of fifteen inches diameter, and ten horse engine, this would be done in three and-a-half minutes, equal to a production of 411 lbs. of ice in twenty-

four hours. There being seventy-five per cent. of water in meat, this would be equivalent to the freezing of 548 lbs. of meat. So that at that rate it would take eleven years to freeze a cargo of 1000 tons. Again, the air contained suspended moisture, and a portion of the cooling power was expended in freezing this moisture, from which 1100 degrees of latent heat would have to be abstracted. It was this very defect that made the delusive show at Chemnitz and Mount Cenis.

Mr. Postle denied the correctness of Mr. Harrison's assertion, and said that a machine by Mr. Kirk had been found far superior to one invented by Mr. Harrison, referring to the "Practical Machines Magazine," of 1863, for a confirmation of the assertion. Mr. Postle also spoke of the science of Thermo-dynamics which he said was not understood by Mr. Harrison, and generally defended the plan he had propounded of preserving meat.

Mr. Harrison objected to being bound by the working of a machine which he had not seen, and the maker of which, as was shown in a chancery suit, had been infringing on one of his patents.

A short discussion took place between the members generally, and the President terminated the subject, by expressing his gratification that the matter was likely to be taken up, and that the colony must eventually benefit by discussions such as had that evening taken place.

(Signed) Robt. L. J. Ellery.

May 11, 1868.

Ordinary Meeting.

Monday, 11*th May*, 1868.

The President, R. L. J. Ellery, Esq., in the chair.

The following contributions to the library were acknowledged :— "Fragmenta Phytographiæ Australiæ," No. 46, by Dr. Mueller. "Tables and Calculations," by Professor C. D. Hall (Lund.); presented by Dr. Mueller.

The President stated that a sub-committee, appointed by the Council to examine and report upon the repairs and additions required to the hall, with a view of yielding members more accommodation at the meetings, obtaining better access to the library and preserving the building and grounds, found that the proposed alterations would cost from £750 to £800. At an early day the Council would come before the members with a definite proposal for raising this sum.

The president read a paper, "Notes on Aneroid Barometers, and on a Method of Obtaining their Errors." (See part 1, Transactions.)

Mr. A. K. Smith said while listening to the clear statement just read, his attention had been called to the Barometer made by

Kilpatrick and Co., in which the word "Stormy" did not appear, he thought an improvement by which a proper adjustment of the words to the readings could be made, so as to adapt them to positions suitable to the locality or latitude in which the barometer was used.

The President agreed that the suggested improvement was of a valuable kind, and trusted it would be carried out. He knew how wedded people were to the kind of directions usually appended, yet as they were now generally placed, "Stormy" stood at 28 in., a depression not often seen in Victoria, our most stormy weather occurring with a much higher reading.

Mr. W. S. Gibbons spoke as to a plan of which the idea had occurred to him—a second dial working on the same centre.

The President preferred Mr. Smith's plan; and a brief conversation took place between Messrs. A. K. Smith, W. S. Gibbons, and the President thereon.

(Signed) Robt. L. J. Ellery.

May 28, 1868.

Ordinary Meeting.

Thursday, 28th May, 1868.

The President, R. L. J. Ellery, Esq., in the chair.

Mr. A. K. Smith read a paper, "On an Improved Method of Rendering Casks Air-tight." (See Part 1, *Transactions.*)

The President inquired if the plan could not be applied to small casks for domestic purposes. Professor Wilson suggested a plan for doing so. Mr. W. S. Gibbons said the bag placed by Mr. Smith within the cask would answer the same purpose at the extremity of the tube, where Mr. Smith placed his reservoir of water.

A discussion took place. Dr. Barker, Professor Wilson, the President, Mr. Gibbons, and Mr. Smith took part. The plan proposed by Mr. Smith met with the general approval of the speakers.

(Signed) Robt. L. J. Ellery.

June 8th, 1868.

Ordinary Meeting.

Monday, June 8th, 1868.

The President, R. L. J. Ellery, Esq., in the chair.

The following contributions to the library were acknowledged :—"Auriferous Drifts in Australia, by Research," "Journal of the Statistical and Social Inquiry Society of Ireland," part 24.

The President read a paper, "On a Method of Keeping Accurate Time in the City, Suburbs, and on the Railways." (See Part 1, *Transactions.*)

Dr. Barker, Professor Halford, and Mr. M'Gowan praised the plan proposed ; and in reply to some inquiry the President said he thought £1 per clock, per annum, would be about the expense of carrying out the scheme, and this Mr. M'Gowan corroborated, saying that in a circuit of three miles, fifty clocks might well be maintained at that price.

The president said he had now to communicate a message from the Council on the proposed alterations.

The message proposed The Erection of a Lodge on the grounds for the residence of a permanent messenger, the partitioning off of the hall, the building a library (to be open daily), with rooms for office purposes, and the stuccoing of the building outside. The total cost was estimated at £800, and it was proposed in the first instance to borrow the amount from the bank, and raise money on debentures to liquidate that advance.

Professor Halford thought it would be better if the Society moved from its present hall to another locality ; the place was a desolate one, and it would be better to get into the Library Reserve.

Dr. Barker said it would be impossible to dispose of the present building, and, moreover, there was very little difference between the place they were now in and the one it was proposed to remove to. If the alterations were carried out as proposed, all the objections suggested by Professor Halford would be removed.

Rev. Dr. Bleasdale objected to spending money on the present building, and said a short act might be obtained by which the hall and grounds could be disposed of. He advocated the Royal Society getting quarters in the Library Reserve, where he hoped to see all the scientific associations collected. He believed the Government would be found willing to purchase the present site, and he thought by the removal of the Society, a grant could be more readily obtained out of funds to be voted for general science, than by the present plan of going yearly begging for relief.

The President said the Council had very carefully considered the pleasant scheme propounded by Dr. Bleasdale, but could not see any advantage to be gained by adopting it. It was thought better to expend money on their own building, than to build on a place in which they would only be upon sufferance. As to the yearly begging for relief, the amount sought for was in aid of publishing the *Transactions*.

Mr. Bosisto objected to applying for a short act, on account of the expense, but approved of removing to a better site. He thought if the Government would purchase, no act would be required, and suggested opening communications with the Government on the subject.

Dr. Barker thought, as some discussion had arisen, it would be as well to call a special meeting on the subject, although he saw no reason to change his opinion. He considered the scheme adopted by the Council most beneficial to the Society.

Mr. R. S. Danson concurred in the calling of a special meeting; and Mr. H. K. Rusden thought it advisable, while prepared to uphold the course the Council proposed.

The President, Professor Halford, Dr. Barker, Rev. Dr. Bleasdale, and other members having spoken briefly on the matter, it was proposed by Dr. Barker, seconded by Mr. R. S. Danson, and carried: "That the further consideration of the subject of the alterations "be adjourned to Monday, the 13th July. The meeting to be "specially convened for the purpose of deciding the question."

(Signed) Robt. L. J. Ellery.

June 25, 1868.

Ordinary Meeting.

Thursday, June 25, 1868.

The President, R. L. J. Ellery, Esq., in the chair.

The following contributions to the library were acknowledged:— "Journal of the Horticultural Society of London," part 2, vol. 8; "Proceedings of the Horticultural Society," No. 10, March, 1868; "Transactions, Imperial Society of Naturalists, Moscow;" "Report of the Free Library Committee, Liverpool," 1867; "Journal of the Statistical Society, London," vol. 30, No. 4, vol. 31, No. 1; "Transactions, Institute Naval Architects," 1867; "Transactions, Royal Society of Edinburgh," 1832-67; "New Zealand"—by Dr. Hochstetter, presented by the Colonial Secretary, New Zealand; "Stabistick Van den Handel en de Scheepvaart op Java en Madura Sedert," 1825, vols. 1 and 2; "Tijdschrift voor Nijverheid en Landbonev in Nederlandsch Indie," Deel II., parts 1, 2, 3, 4, Deel III., parts 1, 2, 3, 4, Deel IV., parts 1, 2, 3, 4; "Notulen der Besturs Vergaderingen van de Nederlandsch Indische Maatschappig van Nijverheid en Landbonev," July 1861 to Dec. 1863, 5 parts; "Sitzsengsberichte der Königl Bayer Akademie der Wissenschaften zu Munich," I. Heft 4, II. Heft 1, 2, 3, 4.

The President called the attention of the members to a paragraph in the *Leader* of the preceding Saturday, referring to the death of the late Mr. Dahlke, and ascribing to this Society a course of action which it had never taken. The facts were—after Dr. Neild had in November, 1867, read a paper drawn up by Mr. Dahlke, "On the Purification of Water," Mr. Cosmo Newbery, one of the Council, entered upon a course of experiments with the filter, the results of which were brought before the Society; but with regard to the value of the experiment in purifying salt-water, Mr. Dahlke was told by several members of the Society that they doubted the result of his operations, and from what was reported of an experiment at Williamstown, care was taken in the annual address delivered on the 26th March, to allude with caution to these proclaimed suc-

cesses. Of Mr. Dahlke's late gigantic experiments the Society had no opportunity of expressing an opinion. And while all latitude must be permitted to the Press, it was only right that facts should be ascertained before criticism should be indulged in.

The President read a paper by T. E. Rawlinson, Esq., C.E., Belfast, "Speculations of the Zodiacal Light." (See Part 1, *Transactions.*)

Messrs. Ligar, Professor M'Coy, and the President took part in a discussion arising out of this paper.

Rev. J. J. Bleasdale read a paper, "On Colonial Gems" (See Part 1, *Transactions.*)

Several rubies found near Berwick were exhibted.

In reply to several questions, Dr. Bleasdale said he believed the specific gravity of the ruby was about 4·012. He had tested it by every known process. Specimens of sapphires had also been found in the same creek. There was some difference between the specimens now produced and those found in Gipps Land and Daylesford.

Mr. Ulrich said six years back he had found an Oriental ruby in a little black sand, and thought records might be found in the Geological Department as to the condition of the specimens from Mount Eliza. He was aware that sapphires had been obtained at Cape Schanck, where the course-grained granite about there formed possibly the matrix.

Dr. Bleasdale, Professor M'Coy, Mr. Ligar, and the President joined in a discussion on the specimens exhibited.

The President gave a description of "A Clock Made for the Sorting Office, General Post-office, Melbourne," and exhibited some photographs of the dial, &c. (See Part 1, *Transactions.*)

In reply to some questions, the President said the Post-office clock was at present lying by, for although the money had been voted, there was none yet applicable for the work. The iron girder was fitted, and he believed the plan could be carried out. It was intended to have four dials of 6 ft. diameter, arranged to admit of being illuminated at night. The clock would strike upon a ton bell 5 ft. diameter with four quarter-hour bells to chime, after the plan at St. Mary's Cambridge. He would mention a novelty connected with it. It was that the minute-hand instead of progressing, would stop at the thirty seconds, and then jump the following half minute. This plan enabled chronometers and watches to be more securely regulated. A valuable suggestion had been made by Mr. A. K. Smith as to the winding-up of the clock, and this was a question of importance, as it must be remembered that the clock at Westminster took nine hours to wind. Mr. A. K. Smith proposed to utilize the Yan Yean, and thus to a certain

extent the clock would be self-winding. He hoped to have the clock made in Melbourne, but was afraid under existing circumstances it would not be tendered for.

Mr. A. K. Smith and other members spoke briefly on the subject.

(Signed) Robt. L. J. Ellery.

July 13, 1868.

Special Meeting.

Monday, July 13, 1868.

The President, R. L. J. Ellery, Esq., in the Chair.

The following contributions were acknowledged :—Vol. XVI., Nos. 95 to 99 inclusively, "Transactions Royal Society"; Nos. 20 and 21, "Anthropological Review."

The President stated the meeting had been specially convened to consider the proposition put forward by the Council for improving the hall, and which had been objected to by one or two of the members when the project was first mooted.

The Hon. Secretary read the minutes of 6th June referring to the proposed alterations.

Dr. Iffla, as a very old member of the Society, advocated the retention of the present building, and urged upon the Council the advisability of appealing to Parliament for a grant in aid for the proposed alterations.

Mr. G. C. Levey, Mr. J. B. Were, and other members having spoken,

Professor Wilson, after explaining the views of the Council upon the subject, moved—"In the opinion of the Society it is inexpedient "that the Society should move from its present site." Dr. Barker seconded this.

Rev. J. J. Bleasdale moved as an amendment—"That the con- "sideration of the subject be adjourned for one month," arguing that the present site was a bad one, and that better quarters could be obtained in the Library Reserve. Mr. G. C. Levey seconded the amendment, as he thought the delay would not be prejudicial to the Society, reserving to himself the right hereafter of supporting the proposition of the Council.

Professor Wilson, Dr. Corrigan, Dr. Iffla, the Rev. J. J. Bleasdale, Mr. Rusden, and the President having spoken, the amendment was put and lost. The original motion was then put and carried.

Professor Wilson then moved—"Subject to a reasonable scheme "for raising the money being placed before the Society, it is "desirable that the alterations recommended by the Council be "carried out."

Dr. Neild seconded this, which was put and carried.

Mr. A. K. Smith moved—"That a deputation consisting of the "Council of this Society wait upon the present Treasurer of Victoria "to request that a sum of £800 be put upon the Estimates for "1868-9, for the purpose of completing the Society's hall in "accordance with the report of the Special Committee."

Mr. Willan seconded this proposition, which was supported by Dr. Iffla, put, and carried.

The President said action would be at once taken in the matter, and progress would be reported at the ordinary meeting to be held on the 30th inst.

(Signed) Robt. L. J. Ellery.

July 30, 1868.

Ordinary Meeting.

Thursday, July 30, 1868.

The President. R. L. J. Ellery, Esq., in the Chair.

The following contributions were acknowledged :—"Transactions Imperial Society, Moscow;" "Journal of the Linnæan Society," 4 Nos.; "Proceedings Royal Geographical Society," No. 1., vol. XII.; "Fragmenta Photographiæ Australiæ," No. 47; "Journal Royal Geological Society of Ireland," vol. 1, part 3; "Statistical Register of Victoria;" "Statistical Notes," complete, 7 vols.; "Statistical Essay and Sheets prepared for the Dublin Exhibition," 2 copies; "Statistics of Victoria," 1867, presented by the Registrar-General of Victoria.

In the absence of those members of the Council that waited on the Treasurer in accordance with a resolution passed at last meeting, the Hon. Secretary (Mr. Rawlings) stated that the Chief Secretary and Treasurer had declined to afford any assistance to the Society.

The President said as Mr. Smith's motion had not emanated from the Council, the Society was in the same position as before, and that a scheme would be placed before the members for providing the funds.

Mr. Bonwick and Professor Halford put certain inquiries as to the aid required, and security for repayment, and Mr. Rawlings explained the financial position of the Society, its power to defray interest on the loan raised, and gradually liquidate the principal.

Professor M'Coy then exhibited and described the teeth and fossil eye of the *Ichthyosaurus Australis* (M'Coy) from the Flinders,

and the large mammalian teeth and palate lately found in the limestones near Geelong. (See part 2, *Transactions.*)

In answer to an inquiry of Mr. Bonwick, Professor M'Coy said that on examination he had found the anterior humerus was broader than that of the African elephant, differing from the humerus of the kangaroo, but assimilating itself nearer to the native bear. It differed from the native bear, however, in its dentition, the bear having numerous molar teeth, while the *Diprotodon* had but four. The animal evidently was Marsupial, and as he had before said, analogous to the sloth of South America. In answer to other questions, Professor M'Coy further stated that the precise locality where the remains were found was recorded in the *Transactions*, as when Mr. Carson, a former pupil of his, had sent him the fossils he had placed them before the Society. He was happy to say that all he had stated years back of the Cretacious fossils of Australia had been strictly corroborated.

Mr. J. C. Newbery read a paper "On the Ornamental Stones of the Colony." (See part 2, *Transactions.*)

Several specimens of the stones referred to by Mr. Newbery were handed round for inspection, and in the discussion that ensued Mr. Ligar brought prominently before the members the advantage which would be derived from the discovery of a sand well fitted for the manufacture of glass. The glass company just established was at present procuring sand at a great distance from the works. Mr. Ligar understood there was sand at Lal Lal, where there was also lignite affording fuel for the works, and a railway giving facilities for carriage.

The President, Professor M'Coy, Messrs. Newbery, Ulrich, Ligar, and Rawlings spoke generally as to the places where sand and the specimens of stone produced could be obtained.

The following gentlemen were proposed as new members, ballot to take place at next election :—

	Proposed by.	Seconded by.
Mr. H. G. L. Brown	Mr Newbery	Mr. Ellery
Mr. John Wilkins, F.R.C.S.	Dr. Nield	Mr. Rawlings
Mr. Albert Richardson	Do.	Do.
Mr. David C. Rees	Mr. T. Harrison	Mr. Ellery.

(Signed) Robt. L. J. Ellery.

August 10, 1868.

Ordinary Meeting.

Monday, August 10, 1868.

The President, R. L. J. Ellery, Esq., in the Chair.

The following contributions were acknowledged :—"On a Scientific Exploration of Central Australia"—by Dr. G. Neumayer ; "Index of Patents Applied for and Patents Granted in the Colony of Victoria," 1854 to 1861—presented by the Registrar-General of Victoria.

The four gentlemen nominated at last meeting were balloted for and declared duly elected.

The following gentlemen were proposed for membership, ballot to take place next meeting :—

	Proposed by.	Seconded by.
Rev. James Moss	Mr. G. S. Manns	Mr. T. Harrison
Mr. E. J. White	Mr. Ellery	Professor Wilson
Mr. Edward Howitt	Mr. Newbery	Mr. Rusden.

The President referred to the alterations in the building, and said that it was proposed to proceed immediately with the work, borrowing money in the first instance from the bank, and repaying that loan by the issue of debentures bearing interest at £8 8s. per cent. per annum. The debentures to be of £5 each, and any member holding three debentures would have the option of converting them into a life membership, now costing £21.

Professor Wilson said as it was very desirable this matter should be treated in a formal manner, and as the recommendation of the Council embraced three propositions, he would submit them singly to the meeting. He then moved—

1. "That the offer of the Melbourne Bank to lend the Royal Society money on promissory notes at six months' each, renewable for two years, and bearing interest at nine per cent., be accepted."

   Mr. Bonwick seconded the motion, which was put and carried.

2. "That two subscription lists be opened and circulated, one for donations to the building fund, and one for debentures of £5 each, bearing interest at £8 8s. per cent. per annum. That the proceeds of these subscription lists be applied to paying the money borrowed from the bank."

   Mr. Ulrich seconded this motion, which was put and carried.

3. "That any member of the Society holding debentures to the value of £15 shall be entitled at any time to surrender his debentures and become a life member of the Society."

   This motion was seconded by Mr. Rusden, and carried.

It was intimated by the President, Professor Wilson, and Mr. Rawlings that the debenture list was not issued with a view of obtaining money to be afterwards converted into donations, but

that the amount so raised would be gradually paid off, and during the continuance of the loan the interest would be paid with the strictest punctuality.

Debentures to the value of £200 were then subscribed for.

Mr. Thomas Harrison read a paper, "Notes on the Various Theories as to the Origin of Species."

Professor Wilson said it was a very difficult matter to comment upon a paper like the one just read. He objected to mixing up the arguments derived from science and those derived from revelation, and thought the blending of the two together stifled discussion, and not suitable for a scientific society.

Messrs. Bonwick, Manns, Thompson, and others concurred with Professor Wilson.

The President said it would be admitted that Mr. Harrison had treated the subject in a very peculiar manner, and agreed generally with what had fallen from the members as to not discussing subjects of a religious character.

Mr. Harrison in reply said he was sorry there was no discussion on his paper, or that it was considered a theological essay. He had used quotations from Scripture because he believed that science and religion agreed together.

(Signed) Robt. L. J. Ellery.

August 27, 1868.

Ordinary Meeting.

Thursday, August 27, 1868.

The President, R. L. J. Ellery, Esq., in the Chair.

The three gentlemen proposed at the last meeting as members were balloted for and declared duly elected.

The following gentlemen were proposed as candidates, ballot to take place at the next meeting :—

	Proposed by.	Seconded by.
Mr. B. Tindall	Dr. Neild	Mr. Rawlings
Mr. J. T. Rudall	Mr. Ellery	Mr. Rawlings
Mr. J. Munday (country memb.)	Mr. H. A. Thompson	Mr. Rawlings

The President reported what progress had been made by the Council in getting the debenture and donation lists filled up, and in preparing the working plans for the alterations, and then stated that his attention had been called in many quarters to a paper read by Mr. A. K. Smith on the 28th May, and subsequently published in the first part of the *Transactions* for 1868. The paper was entitled "On an Improved Method of Preserving Wines and Spirits," and it was asserted to be copied from a patent registered by Mr. Ryan. The President had inquired into the matter, and had supplied Mr. Rawlings with data also to make search into the

specification of Mr. Ryan's patent taken out in 1844. The charge of plagiarism was to a certain extent true, although not as to the greater part. Dr. Ryan's patent provides for the use of a flexible bag being used in a cask, and the use of such a bag was certainly embodied in the scheme of Mr. Smith, but the specialty in Mr. Smith's paper was a contrivance by which the plan could be readily carried out in an ordinary cellar. In fact, the searching after the idea, by wading through the patents would not be compensated for by the slight advantage said to have been gained by the plagiarism.

Professor Halford then offered some further observations on "Snake Poisoning." (See Part 2, *Transactions.*)

A long discussion ensued, in which the President, Mr. Gillbee, Dr. Ralph, Mr. Blair, Mr. Ford, Mr. Ligar, and Professor Halford, took part.

(Signed) Robt. L. J. Ellery.

September 14, 1868.

Ordinary Meeting.

Monday, September 14, 1868.

The President, R. L. J. Ellery, Esq., in the Chair.

The gentlemen proposed at last meeting were balloted for and declared duly elected.

The following gentlemen were nominated as candidates, ballot to take place next meeting :—

	Proposed by.	Seconded by.
Dr. David T. Thomas	Mr. Ellery	Mr. Willan
Dr. W. F. Taylor (country member)	Mr. S.W. M'Gowan	Mr. Ellery.

The following contributions were acknowledged :—"Bericht über den gegenwärtigen Zustand des botanischen Gartens in Breslau"—presented by Dr. Goëppert ; "Memoirs of the Geological Survey, India," vols. 1 to 5, complete ; do. do., vol. 6, parts 1 and 2 ; do. do. Palæontologia Indica, sec. 1, complete ; do. do. do., sec. 2, parts 1 to 6 ; do. do. do., sec. 4, part 1 ; do. do. do., sec. 5, parts 1 to 6 ; "Annual Reports of the Survey Department," 1858 to 1867 ; "Record Geological Survey of India," vol. 1 ; "Catalogue of the Organic Remains Belonging to the Cephalopoda, Echinodermata, and of the Meteorites in the Museum of the Department"—presented by the Superintendent of the Survey under instructions from the Governor-General of India.

The President read a paper by Mr. J. W. Beilby, called "Facts from the Arcana of Nature apparently at variance with the Existing Theories of Science." (See Part 2, *Transactions.*)

The President said the paper evinced much research, and that the author was not alone in the ideas he put forth.

(Signed) Robt. L. J. Ellery.

September 24, 1868.

ORDINARY MEETING.

Thursday, September 24, 1868.

The President, R. L. J. Ellery, Esq., in the Chair.

The gentlemen proposed as members at the last meeting were balloted for and declared duly elected.

The President reported as to the progress made in the alterations, &c.

Professor Halford then exhibited and described "A Deformed Skeleton." (See Part 2, *Transactions.*)

A desultory conversation took place in which the President, Messrs. Marshall, Rusden, Willan, Rawlings, and Professor Halford took part.

(Signed) ROBT. L. J. ELLERY.

October 12, 1868.

ORDINARY MEETING.

Monday, October 12, 1868.

The President, R. L. J. Ellery, Esq., in the Chair.

The following contributions were acknowledged :—"A Descriptive Catalogue of the Rock Specimens and Minerals in the National Museum"—by A. R. C. Selwyn, Esq., Director, and others ; "Observations on the Mode of Occurrence and the Treatment of Auriferous Lead and Silver Ores at Schemnitz, Upper Hungary"—by G. H. F. Ulrich, Esq., F.G S., presented by the Geological Survey Department, Victoria ; Mittheilungen der Kais Königl Geographischen Gesellschaft in Wien, Neue Folge," 1868 ; "Nachrichten von der K. Gesellschaft der Wissenschaften und der Georg-Augusts, Universität aus dem Jahre," 1867 ; "Oberhessischen Gesellschaft für Natur, und Heilkunde, Bericht," VII., IX., X., XI., and XII.

The President read a paper, "Further Observations on the Temperature of Solar Radiation as Measured by the Black Bulb Thermometer." (See Part 2, *Transactions.*)

A conversation took place between Professor Wilson, Mr. Newbery, and the President upon the general inaccuracy of the instruments received in the colony, and the inconveniences arising therefrom.

The President, in reply to an inquiry from Professor Wilson, said he had not had time to prepare a paper, but he had made a few notes, principally with the view of ascertaining the difference in time between the recent earthquakes in Chili and Peru and the appearance of the tidal wave in Australian waters. Members would recollect that a month or two ago the announcement appeared in the papers of an extraordinary tidal wave impinging upon different

parts of the Australian coast. Sydney, Newcastle, New Zealand, and the Chatham Islands were visited, and the wave was even felt to a small extent so far as Guichen Bay and the Gulf of St. Vincent. It was generally supposed that this was to be traced to some earthquake, and the first thing that suggested itself to him (Mr. Ellery) was to reduce the different times as near as possible, so as to arrive at one mean time. He had got the time at Sydney to a few seconds, and pretty accurately at Newcastle, and also with some accuracy in New Zealand, but beyond that he had no reliable data. It was on the afternoon of the 15th August that the tidal wave was experienced in Sydney, &c., and news had now come of the frightful earthquake at Chili and Peru, which was no doubt the cause of the tidal disturbance in these waters. The wave was first noticed at Sydney 2 h. 29 min. on the morning of the 15th August (Melbourne mean time), and the great wave occurred at about 24 min. past seven in the morning. At Newcastle it was first noticed at 7 h. 2 min. in the morning, and five hours afterwards occurred the greatest disturbance. In New Zealand the first disturbance occurred at five a.m., and the greatest wave was not noticed until a little after the hour of noon. The earthquake was reported as having taken place in Chili and Peru on the 13th August, but no hour was mentioned. Assuming at a guess that it took place at an early hour in the morning, say three o'clock, it made it the afternoon here. Between this time and the occurrence of the tidal wave at Sydney, there was an interval of thirty-two hours, and assuming the distance between Callao and Sydney to be about 6,500 statute miles, or 5,700 geographical miles, it gave the velocity of the wave at about 200 miles an hour, a rapidity which to him seem scarcely conceivable. The district in which this earthquake occurred was one in which earthquakes were very prevalent and destructive. It was pretty well understood now that the intensity of earthquakes decreased with the distance from active volcanoes. The first earthquake of any consequence which was fully described was that at Callao in 1747, which was stated to have destroyed the city and all the inhabitants save one. This last earthquake, of which the account has just arrived, must have extended from 1° north to 22° south, and perhaps further. No account had been received from Valparaiso, but it was possible that the earthquake had been destructive as far as that place. It had been pointed out that in the earthquakes on the Chilian coast, these were only the secondary destroying influence—it was the earthquake wave that destroyed life and property. The destructive influence of this earthquake was no doubt felt further south than 22°, for Iquique, where it was experienced very severely, was as low as 21°. He visited that place some years ago, and he recollected that it was near a very active volcano—not more than fifteen miles off. These were some of the facts he had got together, and he would leave it to the other members to discuss the question.

In reply to a question as to whether it had been one rolling wave which had come from South America to this coast, Mr. Ellery said that he thought such could not be the case. No wave could travel so fast as this shock seemed to have done, and it was frequently noticed that quite isolated pieces of water were disturbed just as the sea had been in this case. It was possible that the shock might have travelled a long distance without being noticed, and have shown itself by perpendicular action at particular spots according to the nature of the strata.

Professor Halford suggested the possibility of the calamity in South America having arisen from a submarine explosion, which had communicated its force to the water. That this should shake the neighbouring coast was only what might be supposed.

A discussion ensued, in which Professor Wilson, Professor Halford, Mr. Ulrich, and the President took part. The distance from the seat of the earthquakes at which the shock could be felt, the height of the tidal waves, and suppositions as to its origin, forming the subject.

(Signed) Robt. L. J. Ellery.

October 29, 1868.

Ordinary Meeting.

Thursday, October 29, 1868.

The President, R. L. J. Ellery, Esq., in the Chair.

The following contributions to the Library were acknowledged: —"John Batman, the Founder of Victoria"—by Jas. Bonwick, F.R.G.S.; "Monthly Notices of Papers and Proceedings of the Royal Society of Tasmania," 1867; "Statistics of the Colony of Victoria," 1867, parts 3 and 4—presented by the Registrar-General.

The President then offered some observations in reference to the supposed earthquake wave. (See Part 2, *Transactions*.)

Professor Wilson considered the disturbances at South America and the presence of the wave on this coast as the result of a submarine explosion between the two places, and had drawn that inference from Mr. Ellery's time table just read.

Professor Halford agreed with the idea of submarine explosion, but wished information as to the origin of this eruption. Most people believed in a molten mass below the bed of the sea, and the surface of this mass, he had read, coming in contact with water would on its cooling generate steam, and an explosion through the change of temperature take place. Dr. Tyndall in his various experiments had referred to this view of the question.

Mr. Ellery said Mallet, who was an authority on such matters, came to the conclusion that the greatest earthquake wave, rose

from submarine disturbance near the shore. It might also happen from the breaking-down of the submarine embankments, for which great force would not be required. In support of this he would remark that soundings taken after the appearance of such wave, had differed materially from those taken previously on the same spot.

Professor Wilson said the discussion on this subject opened up the whole theory of the eruption of volcanoes. It must be allowed that molten lava was beneath the earth, and the hydrostatic power beneath the molten lava necessary to cause these eruptions must be of different degrees of force to act upon the different materials. For instance, Vesuvius was of a sandy character, while in South America many of the mountains were of solid stone, and the power required to upheave these would be immense. It was true that hot lava coming into contact with water would explode, but that was the consequence and not the cause.

Mr. D. Rees inquired if there was any other mode of accounting for the transmission of the wave than that given by Professor Wilson: The President could not say, and referred to some observations by Dr. Hector on the subject.

Professor Wilson explained, by a diagram, the motions of a wave at the velocity indicated, 200 miles an hour, or fifty miles in fifteen minutes, and showed that from the gentle character of the slope it would be almost imperceptible to a ship crossing its track, while the power at the point where it touched the land would be very great.

Some other discussion ensued.

Mr. William Walker inquired whether the formation of a single wave was not a physical impossibility. Waves were formed by wind and other forces; when the wind ceased the waves subsided. The tremulous motion felt by ships might be attributed to electricity, the copper bottoms of which formed an excellent conductor.

Professor Wilson said he had been informed that when the "Royal George" was blown up, the shock was felt by a boat before the column of water consequent on the explosion was seen; and Mr. Ellery related a similar case occurring on the Saltwater River when he, with others, were testing a torpedo. The shock felt was that of a blow, not of a vibrating motion usually attendant upon electrical concussion.

Mr. Walker contended that the shock was due to electricity; and after a further discussion, in which the action of the Gymnotus or Electric Eel formed the principal topic, the meeting adjourned.

(Signed) Robt. L. J. Ellery.

November 9, 1868.

ORDINARY MEETING.

Monday, November 9, 1868.

The President, Robt. L. J. Ellery, Esq., in the Chair.

The following contributions to the Library were acknowledged :—"Statistica Del Regno Italia," 1866—presented by the Italian Consul; "Sixth Letter to the Duke of Buckingham"—by Mr. Thomas Parsons.

The Hon. Secretary stated that in accordance with Law IX. the following vacancies were declared :—The President, Vice-Presidents, Secretary, Treasurer, Librarian, Curator; and seven seats in the Council caused by the retirement of Captain Kay, Professor M'Coy, Messrs. Gillbee, Ligar, Higginbotham, Thompson, and Wild. Nominations to supply these vacancies must be made under Law X.

Mr. Rawlings read a paper contributed by Mr. H. A. Thompson, "Notes on the Secondary Beds of North Australia." (See Part 2, *Transactions*.)

Mr. Ulrich regretted the absence of Mr. Thompson, as it prevented him obtaining a reply to any doubts he might express as to the correctness of the conclusions arrived at by the author.

Mr. Bonwick considered the sandstone of a Tertiary character, and said Mr. Graham, of Queensland, bore him out in this opinion. At the same time there were the fossils to be accounted for.

Mr. Ulrich considered that from denudation of the secondary deposits the fossils had been received into the Tertiary beds. Mr. Daintree who, he believed, would examine that part of the country, would most likely throw some light on the matter, and confirm Mr. Thompson's opinion or otherwise.

Mr. Newbery said he had inspected several specimens brought down by Mr. Thompson, and had found them rounded on the edge. He agreed with Mr. Ulrich's deductions.

(Signed) ROBT. L. J. ELLERY.

November 26, 1868.

ORDINARY MEETING.

Thursday, November 26, 1868.

The President, R. L. J. Ellery, Esq., in the Chair.

The following contribrutions were acknowledged :—"Australian Diseases"—presented by the author, Jas. B. Clutterbuck, Esq., M.D., L.S.A.; "The Anthropological Review," No. 23; "Report on Epidemic Cholera and Yellow Fever in the Army of the United States during 1867"—Presented by the War Department, Washington; "Ezechiels Syner og Chaldærnes Astrolar"—by C. A. Holmbe; "Ungedruckte Unbeachtete und wenig beachtete Quellen zur Geschichte des Taufsymbols und der Glaubensregel"—Dr. C. P. Caspari; "Veiviser Ved Geologiske Excursioner, I. Christiania

Omegn med et farvetrykt Kart og flere Træsnt"—by Dr. Kjerulf; "Norges Ferskvandskrebsdyr forste Afsnit Branchiopoda"—Dr. Sars; "Bidrag til Bygningskikkens Udvikling paa Landet, I. Norge; "Om de I. Norge Forekommende Fossile Dyrelevninger Fra Qvartœrperioden, et Bidrag til vor Faunas Historie"—Dr. Sars; "Mœrker Efter en Iistid, I. Omegnen af Hardangerfjorden"—S. A. Saxe.

Mr. William Lynch, solicitor, Collins-street west, Melbourne, proposed by Dr. Neild, seconded by Mr. Rawlings, for ordinary membership, ballot to take place next meeting.

Messrs. H. G. L. Brown and J. T. Rudall, M.R.C.S., subscribed the roll of membership.

Mr. MacGillivray gave a "Description of Some New Genera and Species of Australian Polyzoa" (see Part 2, *Transactions*), and afforded members an opportunity of inspecting the specimens under the microscope.

Mr. Rawlings read "A Sketch of a New Theory of the Oceanic Tides, based upon Examination of the Causes Assigned to Exceptional Tidal Waves"—communicated by Mr. J. Wood Beilby. (See Part 2, *Transactions.*)

Professor M'Coy thought the theory propounded a novel one, and objected to the assertion as to the changes of the axis of rotation. The general statement was physically impossible, and appealing to the President to corroborate his statement, the professor by the aid of a diagram pointed out the improbabilities of Mr. Beilby's paper, contending that there was sufficient data to account for all the appearance of earthquake waves without the inadmissable plan of the changes of the axis.

The President said Mr. Beilby was working in the same track in which Count Huon and Adhémar had gone before; he considered Professor M'Coy had exhibited the errors in the paper, but he must give Mr. Beilby credit at the same time for his love of inquiry.

Mr. Wyatt (a visitor) and Dr. Bleasdale joined in the discussion.

Professor M'Coy referring to that portion of the paper which alluded to the change of level in the coast at Brighton, said it was well known that the south coast was gradually rising. In England the same changes had been noted—rising on one side and the eastern counties going down. These were common changes, and well understood.

The President said that an old member of the Society, the late Dr. Becker, had in that hall, first spoken of the rising of the south coast of Australia. In those days there were no tidal guages nor reliable beach-marks to test the correctness of the data.

After a few observations from Professor M'Coy in continuation of his former remarks the meeting adjourned.

(Signed) Robt. L. J. Ellery.

December 14th, 1868.

ORDINARY MEETING.

Monday, December 14, 1868.

The President, R. L. J. Ellery, Esq., in the Chair.

The following contributions were acknowledged :—"Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften"—M. P. Classe, Wien, LVI. Band, 5 Nos.; "Jahrbuche der Kaiserlich Koniglichen Geologischen Reichsenstalt," 1850-9, 1861-2, 2 Nos.; "Journal of the Royal Dublin Society," No. 34.

Messrs. A. K. Smith and Rusden having been appointed scrutineers, a ballot took place for Mr. Wm. Lynch as an ordinary member, who was declared duly elected.

Messrs. J. S. Butters, M.L.A. and Thomas Reed were elected auditors, upon the proposition of Mr. A. K. Smith, seconded by Mr. H. K. Rusden.

Nominations were made for the vacant offices, the elections to take place in January; and Messrs. Rawlings, Rusden, and Ellery gave notice of alteration in various laws, consideration of which to be brought forward at the annual meeting.

(Signed) ROBT. L. J. ELLERY.

CATALOGUE OF THE BOOKS.

Aanteekeningen van het verhandelde in die Sectie verganderingen : Te Utrecht. 1857 to 1860. 6 Nos.

Abhandlungen Aus dem Gebiete der Naturwissenschaften. Hamburg, 1860-6. 4 parts.

Abhandlungen der M. P. Classe der Koniglich. Bayer. Akad der Wissenschaften. 18 parts.

Abhandlungen der Schlesischen, Gesellschaft fur Vaterlandische Cultur. 1861-6. 14 parts.

Abhandlungen herauusgegeben vom Naturwissenchaftlichen Vereine zu Bremen. 1 Bd. Heft. 1, 2. 1866-1867.

Aborigines of Victoria, Report on the. 1858-9.

Académie des Sciences, Paris. Comptes rendus Hebdormaires des Seánces. Vol. LXV., No. 11.

Academy of Natural Science, Philadelphia. Proceedings of 1856-7. (Incomplete.)

Academy of Science of St. Louis, U. S., Transactions of. 1857 to 1860. 4 parts.

Acclimatisation of Animals, On the. Frank Buckland.

Acclimatisation of Harmless, Useful, Interesting, and Ornamental Animals and Plants. G. D. Francis.

Acclimatisation Society of Victoria, Second Annual Report of. 1863.

Actinien Echinodermen and Würmer. A. F. Grube.

Additamenta ad Georgii Augusti Pritzelii Thesaurum. E. A. Zuchold.

Agricultural and Horticultural Society of Madras, Report of. 1860.

Akademie der Wissenschaften. 1855 and 1859.

Akademie der Wissenschaften zu München, Sitzungsberichte der Königl. Bayer. 1860 to 1867. 62 parts.

Akademie der Wissenschaften, Wein, Sitzungsberichte der Kaiserlichen. 19 parts.

Akademie der Wissenschaften, Wein Geschafts Ordnung. 1866.

Algarum Species, Genera et Ordines. 1848, 1851, 1852, 1863. J. G. Agardh.

Almanach der Königlich. Bayerischen.

Alms Houses of New York, Reports of. (6th, 7th, 9th.)

American Lakes, Topographical Report on the. J. D. Graham.

American Academy of Arts and Sciences, Proceedings of the. Vols. 1 to 6.
American Academy, Memoirs of the. 4 parts.
Antiquaires du Nord, Memoires de la Société. 1855-1857. 1 Vol.
Do. 1845-9. 1850-60.
Antiquarisk Tidsskrift (Copenhagen). 1854 to 1860. 5 parts.
Anatomie von Argas Persicus. C. Heller.
Annaler for Nordsk. Oldkyndighed. 1858-9. 2 Vols.
Anschaffung Naturwissenschaftlichen Apparate und Sammlungen für die Volkschule. M. Schlichting.
Anthropological Review. Parts 2, 3, 5. 18 to 23.
Do. Society, Fellows' List of.
Araignées, Sur l'Evolution des. E. Claparéde.
Astronomical Observations made at Melbourne University, Result of. R. L. J. Ellery.
Astronomical Observations made at Sydney Observatory. 1859-60. 2 Vols. Rev. W. Scott.
Astronomical Observatory. Half-yearly Reports.
Atlas de l'Archeologie du Nord.
Atherosperma Moschatum, chemische untersuchung der Rinde. N. J. Zeyer.
Atlantis, a Register of Literature and Science. No. 5.
Auriferous Drifts of Australia, By Research.
Australia, General Map of the Board of Land and Works.
Australian Medical Journal.
Australian Magazine. Nos. 1, 2.
Australian Essays. James Norton.
Australian Diseases. James B. Clutterbuck, M.D., L.S.A.
Australasiatic Reminiscences of D. Bunce.
Batman, John, The Founder of Victoria. J. Bonwick, F.R.G.S.
Barometer Manual. Rear-Admiral Fitzroy.
Bedeutung Moderner Gradmessungen die. C. M. Bauernfeind.
Bemerkungen über die Phyllopoden. A. E. Grube.
Beobachtungen über niedere Seethiere. C. Mettenheimer.
Beskrivelse over Lophogaster Typicus. M. Sars.
Besturs Vergaderingen Notulen der van de Nederlandsch-Indioche Maatschappig van Nyverheid en Landbouw. 1861-63. 5 parts.
Bibliotheca Photographica.
Bidrag til Bygningskikkens Udvkling paa Landet. I. Norge.
Biographische Skizzen verstorbener Bremischer Aerzte und Naturforscher.
Birds of Australia, Introduction to. By J. Gould.
Bodleian Library, Oxford, Donations to.
Boston (U.S.), Museum of Comparative Zoology, Annual Report of the Trustees of.
Boston (U.S.), Society of Natural History, Constitution and Bye-Laws of.

Boston (U.S.), Journal of Natural History. 1861-1863. 3 Nos.
Do. do. Proceedings of. 1854 to 1866.
Do. do. Memoirs Read before the. 1866. 2 parts.
Botanische Mittheilungem. Dr. Goëppert.
Botanischen Gartens in Breslau, über dan gegenwärtigen Zustand Berichte. Dr. Goëppert.
Botanischen Produkte der Londoner-internationalen Industrie-Ausstellung. F. Buchenau.
Botridium Granulatum, On the Structure and Developement of. G. Lawson.
Botanical Report on the North Australian Expedition. Dr. F. Von Mueller.
Botanical Society of Canada, Annals of the. Vol. 1. Part 1.
Botanical Royal Society of Edinburgh, Transactions of. 8 parts.
Brackwasse-Studien au der Elbemündung. J. R. Lorenz.
British North America, An Address on the Present Condition, Resources, and Prospects of. The Hon. Mr. Justice Haliburton.
Buckingham, Duke of. Sixth letter to. By Thomas Parsons, Esq.
Bulletin of the Museum of Comparative Anatomy. Massachusetts.
Bulletin de la Société Imperiale de Moscou. 9 parts.
Calendar of the Melbourne University.
Californian Academy, Proceedings of the. Vol. 2.
Cambridge Philosophical Society, Transactions of the. 1851, 1853, 1856, 1858.
Carl Christian Rafn, Notice on the Life and Writings of. L. E. Bowing.
Catalogue of the Victorian Exhibition of 1861.
Catalogue of the Casts, Busts, &c., in the Museum of Art at the Public Library, Melbourne.
Catalogue of the Melbourne Public Library.
Catalogue, Do. Supplemental.
Catalogue of the Manchester Free Library.
Catalogue de l'Exposition des Produits de la Colonie de Victoria. 1861.
Catalogues of Scientific and other works. 16 pamphlets.
Central American Affairs, and the Enlistment Question. 1856.
Central Australian Exploration. By Dr. G. Neumayer.
Central Railway Terminus for Melbourne. By "Logic."
Cellular Vegetabili Fibrilis de. J. G. Agardh.
Chatham Islands, Vegetation of the. F. Von Mueller.
Chemie Handbuch der Theoretischen. Abth 4. L. Gmelin.
Chemistry in its Application to Agriculture, Letters upon. J. Macadam, M.D.
Chiasmodon, On the Genus. A Carte.
Cholera, Report on, United States Government. 1866.
Do. do. and Yellow Fever. 1867.

Cinchonaceous Glands in Galliaciæ. G. Lawson.
Cirklers Beröring. C. M. Guldberg.
Civil Engineers, Institution of, Charter, Bye-Laws, &c.
Claims between the United States and Great Britain, Report of the Commission of. 1856.
Clinical Reports. D. B. Reid.
Coal Fields in Tasmania. C. Gould.
Coal in Tasmania. Brown and Larnach.
Coast Survey (U.S.), Report of the Superintendent of the. 1857.
Collisions at Sea and Shipwrecks. C. J. C. Perry.
Colonie Victoria in Australia.
Commerce and Navigation, Report of the Secretary of the Treasury upon. 1851-4. 2 vols.
Comparative Petrology, Essay on. M. J. Darcher.
Constitutional Representation in Victoria. "Amor Patriæ."
Contributions ad Acaciarum Australiæ Cognitionem. F. Von Mueller.
Contributions to Conservative Surgery. J. G. Beaney.
Contributions to Practical Surgery. J. G. Beaney.
Copopedon zur Anatomie und Entwickelungsgeschichte. C. Claus.
Cotton Fibre, Microscopical Structure of. G. Lawson.
Dannenirke og Omegn. C. C. Lorenzen.
Darwin's Lehre und die Specification. E. Hallier.
Davidson's Precedents and Forms in Conveyancing. Vol. 2. Part 1.
Denkrede auf Johann Nepomuk Von Fuchs.
Denkrede auf T. Siber und G. S Ohm
Denkrede auf J. A. Wagner. (2).
Denkrede auf G. H. von Schubert.
Denkschriften der K. Bayer. Botanischen Gessellshaft zu Reyensberg. 1859.
Dennisona Barklya et Laboucheria. F. von Mueller.
Denschrift zur feier ihres 50 Jährigen Bestchens.
Deutsche Monatschrift für Australien. Heft 1.
Deutsche Naturforscher and Aerzte in Bremen. Smidt and Focke. Abth 2.
Diabetes Mellitus, On the Phenomena of. Rev. S. Haughton.
Dissertatio Anatomico-Physiologica Inauguralis. F. A. G. Miguel.
Double-Jointed Pessary, On a. D. E. Wilkie, M.D.
Dovres Flora, Supplementer til. F. Hock.
Dudley Observatory, Reply to the Statements of the Trustees of. B. A. Gould.
Dyeing Properties of Lichens. W. L. Lindsay.
Entomologisk Reise. H. Siebke.
Entstehung und Begriff der Naturhistorichen Art. C. Nageli.
Entwicklung die, ideen in der Naturwissenchaft. J. von Liebig.
Entwickelungsgeschichte der Ampullaria Polita Deshayes. C. Semper.
Erdbeben das, in der Provinz Preussisch Schlesien.

Erinerung an Mitglieder der M. P. Classe. C. E. P. von Martius.
Erlaüterung der Steinkohlen Formation. Dr. Goëppert.
Ethnological Journal. (6 parts).
Exploration Expedition to the Gulf of Carpentaria. Commander W. H. Norman.
Ezechiels Syner, og Chaldæernes Astrolar. C. A. Holmbe.
Familien die, der Anneliden. A. E. Grube.
Family Immigration for Victoria. J. Jamieson.
Feinere Bau und das Wachsthum des Hafhorns der. J. Ravitsch.
Fiji and the Fijians. T. Williams 2 vols.
Finances of the United States, Report on the State of. 1854 to 1857. 3 vols.
Fine Arts Courts in the Crystal Palace. 2 vols.
Flora Australiensis. Bentham and Von Mueller. Vols. 1, 2, 3.
Flora Braziliensis. 3 parts.
Flora Bremensis.
Fossile Fauna der Silurischen Diluvial Geschiebe von Sadewitz bei Oels. F. Roemer.
Fossile Mollusken. M. Hörnes. 2 parts.
Fragmenta Phytographiæ Australiæ. F. von Mueller. 47 parts.
Francis Bacon von Verulam. J. F. von Liebig.
Freie Hansestadt Bremen und ihr Gebiet. F. Buchenau.
Ganmenfalten und Nebenzungen der Chiroptern. F. Kolenati.
Gedachtniszrede. F. Tiedmann.
Gems and Precious Stones in Australia. Rev. J. J. Bleasdale, D.D.
Geognostische Skizze des Grossherzogthums. F. Becker.
Geognostische Uebersichskarte von dem Grossherzogthum Hessen. F. Becker.
Geographical Society Royal, Proceedings of the. 1861 to 1867. 36 parts.
Geological Society of London, Quarterly Journal of the. 1856 to 1867. 26 parts.
Geological Society of Ireland, Journal of the. 5 parts.
Geological Society of Dublin. 1844 to 1863.
Geological Survey of India, Memoirs of the. Vols. 1 to 5, vol. 6. Parts 1 and 2.
Do. do. Palæontologia Indica. Sec. 1.
Do. do do. „ 2, parts 1 to 6.
Do. do. do. „ 4, part 1.
Do. do. do. „ 5, parts 1 to 6.
Do. do. Records of. Vol. 1.
Do. do. Annual Reports of. 1858-67.
Do. do. Catalogues of the Organic Remains belonging to the Cephalopoda, Echinodermata, and of the Meteorites in the Museum of.
Geological Reports on the Wairapu Coast. J. C. Crawford.
Geological Explorations of the West Coast of New Zealand. J. Häast.

Geological Formation in Timaru District. J. Häast.
Geologiske Undersögelser. T. H. M. Irgens.
Geologiske og Zoologiske Jag Hagelser. M. Sars.
Geology for Beginners. G. F. Richardson.
Geometrische Repräsentation über die. C. A. Bjkernes.
Germanische Todtenlager bei Selzen. 1848.
Geschlechte der Pflanzen, die Lehre vom. L. C. Treviranus.
Glauben als die Hochste Vernunft. R. Grau.
Glasgow Philosophical Society, Proceedings of. 1841 to 1865. 21 Nos.
Glossaria Linguarum Brasiliensium.
Gold Ores, Notes on the Reduction of. H. A. Thompson.
Gould, Dr., Defence of. (Albany, U. S.)
Granitic Rocks of Donegal, On the. R. H. Scott.
Granitic Rocks South-west of Donegal. R. H. Scott.
Granites of Donegal, On the Chemical and Mineralogical Constitutions of the. R. H. Scott.
Grenzen and Grenzgibiete. G. Harlesz.
Grundzüge der Schlesischen Klimatologie. J. G. Galle.
Gunpowder Patent. Pedro Nisser.
Harbours of Lake Michigan, &c., Improvement of the. J. D. Graham.
Hauptschule zu Bremen, Programm der.
He Maramtaka ara he Pukapuka. 1849.
Hobart Town Directory.
Höheren Gewerbschule in Cassel, Programm der. J. Hehl. 1845-6, 1846-7, 1848-9, 1854.
Horticultural, Royal, Society's Proceedings. 8 parts.
Do. do. Journal. 4 parts.
Houille sur la, Structure de la. Dr. Goëppert.
Hugh Miller, Notice of Some Remarks by the late.
Icones Algarum Ineditæ. C. A. Agardh.
Increase, the Law of. F. P. Liharzik.
India, Album of Photographic Views in.
Induction and Deduction. J. von Liebig.
Inscription Runique du Pirée, Publiè par la Société des Antiquaires du Nord.
Isthmus of Suez Canal Question. 2 pamphlets by D. A. Lange.
Jahresbericht (Erster) des Vereins für Erdkunde in Dresden.
Jahresbericht des Pollichia (Neustadt). 1855-6.
Jahresbericht der Naturwissenschaftlichen Vereines zu Bremen. 2 parts.
Jahresbericht (Zweiter) ut Supra.
Jahresbericht der Pollichia der Rheinfalz. 1859-61-3.
Jahresbericht der Pollichia eines Naturwissenschaften Vereins der Bayerischen Pfalz. 1843.
Jahresbericht über die Real die Provinzial, Gewerbe und die Handwerker Fortbildungs Schule zu Munster.

Jahresbericht der Schlesischen Gesellschaft für Vaterlandische Kultur. Breslau. 24 parts.
Jahrbuch der Kaiserlich Koniglichen Geologischen Reichsanstalt 35 parts.
Japan, Naval Expedition to, Report of the Secretary of the U.S. Navy on, 1854.
Jean Baptiste Biot. C. F, P. von Martius.
Kartoffeln die Krankheit der 1845. G. W. Focke.
Klima von München. C. Kulm.
Komet Bauernes Indlyrdes Beliggenhed. H. Mohn.
Kongelige Norske Fredericks Universitets. 1861.
Kongelige Fredericks Universitets Halvhundredaars fest Sept., 1861.
König Maximillian II. und die Wissenschaft. J. von Dossinger.
Kreideflora über die fossile. Dr. Goëppert.
La Influencia del Cultivo del Arroz in la Salud Publica. J. B. Ullersperger.
Languages, Study of. H. Lafargue.
Lebenden Natur, Welche Auffassung der. K. E. v. Baer.
Leitfaden zur Nordischen Alterthumskunde.
Lepas Anatifera, Remarks on. G. Lawson.
Leprosy, Report of Royal College of Physicians on. 1867.
Linnæan Society of London, Proceedings of. 1848-55.
Do. do. 1856 to 1868. 56 parts.
Literary and Philosophical Society of Manchester, Proceedings. Vols. 2, 3, 4.
Do. do. do. Memoirs of. 1 and 2.
Literature, On the Profession of. G. Craig.
Liverpool Institute, Proceedings and Reports of. 8 Pamphlets.
Ludwig Leichardt. E. A. Zuchold.
Lunar Atmospheric Tides of Melbourne. Dr. G. Neumayer.
Lunar Tidal Wave in the North American Lakes. J. D. Graham.
Lychonopora Martius. C. H. S. Ripontinus.
Maandeiljksche Zeilaanwijzingen van het Kanaal naar Java. 2 parts.
Madras, Journal of Literature and Science. Pt. 1 to 12. (Pt. 9 wanting)
Magnetic Observations, Results of. Dr. G. Neumayer.
Magnetic Orbit, Observations on. H. M. Grover.
Magnetic, Nautical, and Meteorological Observations at the Flagstaff Observatory, Melbourne, Results of. Dr. Neumayer.
Mammalian Fossils in Ireland, Catalogue of. R. H. Scott.
Marche Annuelle du Thermomètre et du Baromètre in Neerlande, Sur la. C. H. Buys Ballot.
Mærker efter en listid I Omegnen af Handangerfjorden. S. A. Saxe.
Measurements for Distinguishing the Human Races. K. Scherzer.
Message from the President of the United States.
Metamorphose die, des Caryoborus. A. E. Grube.
Menschen und des Hühnchens, die Entwickelung des. M. P. Erde.

Meteorit von Brannan. C. H. Beinert.
Meteorites on the Earth, Conversation on the Phenomena attending the Fall of. Haidinger.
Meteorological Observations in Victoria, Instructions for the Guidance of.
Meteorological Reports, Second. R. B. Smyth.
Meteorological Observations in Hobart Town, Results of Twenty Years'.
Meteorological Observations in Hobart Town, Results of Twenty-five Years'.
Meteorological Observations taken at Adelaide.
Meteorological Observations in South Australia. C. Todd.
Meteorological Observations. A Uniform System of. R. Lachlan.
Meteorological Observations taken at the Stations of the Royal Engineers, Abstracts from. 1853 to 1859. Col. H. James, R.E.
Meteorological Observations in the United States. 1864.
Meteorological Observations in the Mauritius. 1864-5.
Meteorological Society of Mauritius, Proceedings of. 3 parts.
Meteorologische Waarnemingen in Nederland. 8 parts.
Meteorologische Beobachtungen auf Christiana's Observatorium.
Mineralogy and Geology, Notes on. Rev. S. Haughton. 17 pamphlets.
Mining Companies, Notes on the Management of. H. A. Thompson.
Mining Surveyors' Reports. No. 1 to 18. (7, 14, 15, 17 wanting.)
Mineralogie die. F. von Kobel.
Mikropische Probeojecte, über. J. J. Pohl.
Mittheilungen der Kaiserlich Königlichen, Geographischen Gesellschaft. 1862, 1864, 1868.
Month, The. No. 1.
Monatsbericht der Königlichen Preuss. Akademie der Wissenschaften zu Berlin. 57 parts.
Mosses, Australian. F. von Mueller.
Musci und Desmidiæ, Reports on. G. Lawson.
Nachrichten von der Gesellschaft der Wissenschaften und der Georg-Augusts-Universität. 1865, 1866, 1867.
Naturgeschichte der Insecten. E. Heeger.
Naturforschenden Gesellschaft in Emden. M. A. F. Prestel.
Naturforschenden Gesellschaft in Danzig, Schriften der.
Natur und Geist. L. Büchner.
Naturwissenschaftlichen Vereine zu Bremen.
Naval Architects, Transactions of the Institution of. 8 volumes.
New Zealand. Dr. Hochstetter.
Norges Farskvandskrabsagr forste afsnit Branchiopoda. Dr. Sars.
Northern Triangulation. G. W. Goyder.
Norske Vœgtlodder. C. A. Holmboe.
North-west Expedition, Report on the, of 1864.

North Australia. Rev. J. E. T. Woods.
Northern Society of Antiquaries of Copenhagen, Miscellaneous Papers of. 1848 to 1863.
Not Like Man. Professor G. B. Halford.
Notulen der Bestuars-Vergardarin van de Nedulansch Indische Maatschippig van Nyverheid en Landbona. 2 parts.
Notziblatt des Vereins für Erdkunde. 3 parts.
Observatory and Telegraphs, South Australia. C. Todd.
Oberhessichen Gesellschaft für Natur und Heilkunde Giessen. 5 parts.
Ode in Honour of the Visit of H.R.H. Prince of Wales to Canada. John May.
Offentlichen Prufüng der Schuler des Kurfürstlichen Gymnasiums zu Marburg. 1857-1860.
Ohio Agricultural Report. 1856.
Om de I Norge Forekommende Fossile Dyrelevninger Fra Quartærperioden et Bidrag tie vor Yaunas Historie. Dr. Sars.
Ores, Lead, and Silver, Auriferous, Observations on the Mode of Occurrence, and the Treatment of at Schemnitz, Upper Hungary. By G. H. F. Ulrich, F.R.G.S.
Oratio de Regno Vegetabili. F. A. G. Miguel.
Oversigts over det Konelige Danske Videnskubernes Selskabs. 1860, 1861, 1862, 1863, 1864.
Pacific Ocean, Reported Dangers in. United States Naval Department.
Patents, Index of, Applied for and Patents Granted in the Colony of Victoria. 1854 to 1861. W. H. Archer, Registrar-General.
Patents, Letters of Registrations and Inventions. Sydney. Parts 1 and 2.
Patent Office Reports, United States. 1855, 3 vols.; 1857, 4 vols.; 1858, 4 vols.; 1859, 4 vols.
Petrel, On an Undescribed Species of. A. Carte.
Petolostigma Quadriloculare Chemisché Untersuchung der Reude. Carl Von Falco.
ΠΕΡΙ ΤΗΣ ΚΑΤΑΣΚΕΥΕΣ.
Pharmaceutical Society of Victoria, Transactions of the. Nos. 3 and 5.
Philosophical Society of New South Wales, Transactions of. 1862 to 1865. 1 vol.
Plains and Rivers of Canterbury, New Zealand, Reports upon. W. J. Doyne.
Plants Collected on the Estuary of the Burdekin. F. von Mueller.
Plants Indigenous to the Colony of Victoria. F. von Mueller.
Political Economy, Lectures on the Common Truths of. J. T. Danson.
Porrasitischer Crustaceen, ueber den Bau und die Entwickelung. C. Claus.

Portland (U.S.) Society of Natural History, Transactions of the 3 parts.
Presbyterianism in the Australian Colonies. Pamphlets.
Proeschel's Map of Victoria.
Rakaia River (New Zealand), Report on the Head Waters of. J. Haast.
Railway and Harbour Accommodation in Victoria. J. Oldham and T. E. Rawlinson.
Rainfall and Evaporation in St. Helena. J. Haughton.
Rainfall and Evaporation in Dublin. J. Haughton.
Realschule zu Cassel, Programm der 1853, 1857.
Recenzio Specierum Genesis Pleridis. J. G. Agardh.
Reizen over Moskovie door Persie en Indie. C. De Bruin.
Recrutirungs-Geschäftes, Ueber die Branchbarkeit der in Verschieden Europaischen Staaten. Dr. T. L. W. Bischoff.
Richtung und Stärke des Erdmagnetismus, Untersuchungen über die. J. Lamont.
Royal Dublin Society, Journal of. 11 parts.
Royal Kalender (Tasmania). 1859–60.
Royal Society of Arts and Sciences of Mauritius. 1861–1865. 4 parts.
Royal Society of Edinburgh, Proceedings of. Parts 1 to 67.
Royal Society of London, Proceedings of. Vols. 6 to 10. 44 parts.
Royal Society of Tasmania, Various Papers and Proceedings. 1859 to 1867.
Rocks, Specimens and Minerals in the National Museum, a Descriptive Catalogue of. By A. R. C. Selwyn (Director), and Messrs. Aplin, Ulrich, Etheredge, and Taylor.
Sarcine la, de l'Estomac. W. F. R. Suringar.
Satzungen des Vereines für Erdkunde in Dresden.
Schleswigsche Wattenmeer und die Friesischen Inseln. C. P. Hanfen.
Schriften der Königlichen Physikalisch, Okonomischen Gesellschaft zu Königsberg. 10 parts.
Scotland, Institution of Engineers, Transactions of the.
Scottish Society (Royal) of Arts, Transactions of. 7 parts.
Secundäre Mineralbildungen über. G. Tschermak.
Seelenstörungen in ihrem Wesen und ihrer Behundlung. E. Ricker.
Settled Districts of Melbourne. 1863.
Siphonodentalium Vitreum, On. M. Sars.
Smithsonian Institution, Annual Report of the. 7 vols.
Do. Miscellaneous Collection. Vols. 1, 2, 3, 5, 6, 7.
Do. Contributions to Knowledge. Vols. 11–12.
Société des Sciences Naturelles, Luxembourg. Tome 16.
Southern Gold Fields, Researches in. Rev. W. B. Clarke.
Staat's Calender der Freien Hansestadt Bremen. 1842, 1856.
Standard, The, Free Presbyterian Magazine of Victoria. 1861.

Statuten der Pollichia, Neustadt.
Statistics of Victoria—
Statistical Notes (complete). 7 vols.
Statistical Register.
Statistical Essay, and Sheet Prepared for the Dublin Exhibition.
Statistics of Victoria. 1867. Parts 1, 2, 3, 4.
W. H. Archer, Registrar-General.
Statistical Register of South Australia. 1861.
Statistical Society, London Journal of. 1857 to 1868. 52 parts.
Statistical and Social Enquiry Society of Ireland. Parts Nos. 33, 34, 35.
Statistica del Regno D'Italia. 1866.
Statistiek van den Handel en de Scheepvaart op Java en Madura. Deel 1, 2.
Steamer, Paper on the most Profitable Speed for a Fully Laden Cargo. J. R. Napier.
Steamer (Tug), for the River Godavery, Description of. J. R. Napier.
Steam Saw, Balancing of, Papers relating thereto, with a Memoir of D. Elder, Esq., and a Rule for the Displacement of Ships. J. R. Napier.
Strictures on the Yan Yean Waterworks. J. Millar.
Stuart and M'Kinlay's Explorations.
Sydney Magazine. 1857.
Systema Vegatabilium. C. H. Persoon.
Tafeln zur Bestimmung dei Mineralien. F. v. Kobell.
Taxidermi fur Universitet og dets Samlinger.
Telegraph, European and Australian. C. Todd.
Thätigkeit der Allgemeinen Naturwissenschaftenlichen Sekiton Gesellschaft. Goëppert und Romer.
Thätigkeit des Vereins für Naturkunde in Cassel. 1837 to 1847. 22 pamphlets. R. M. Phillipi.
Theoria Systematis Plantarum. J. G. Agardh.
Tijdschrift voor Indische Taal-land-en Volkunde. 1857 to 1862. 23 parts.
Tijdschrift voor Nijverheid in Nederlandsch Indie. 30 parts.
Tijdschrift voor Nijverheid en Landbousv in Nederlandsch Indie. 23 parts.
Topographical and Geological Exploration (N.Z.), Report of. J. Haast.
Travaux Scientifiques, Notice sur les de. M. H. Baillon.
Travels in Great Britain. Dosabhoy Framjee.
Uitkomstein van Wetenschap en Ervaring. 1858, 1859. 2 parts.
Ungedruckte Unbeachtete und wenig beachtete Quellen zur Geschichte des Tanfsymbols und der Glaubensragel. Dr. C. P. Caspari.
University Reform. (Kingston, 1861.)
Upsaliensis Nova Acta Regiæ Societatis Scientiarum. 6 parts.

Urbau und Ertrag des Bodens. F. B. W. v. Hermann.
Urzeit die der Erde. F. V. Kobell.
Vegetable Products of Norway, Synopsis of. F. C. Schäebeler.
Veiledning til Dyrnkning af Glaciale Alpinske og Artiske Planter. N. Moe.
Veiviser ved Geologiske Excursioner I Christiania Omegn medat farvetrykt kart og flere Træsnit. Dr. Th. Kjerulf.
Vergaderingen van het Bataviaasch, Genootschap van Kunsten en Wetenschappen. 1857. 3 parts.
Verhandelingen van het Bataviaasch Genootschap. Deel 17, 18, 19.
Verhandlungen der Kaiser. Lepold Carolin Deutschen Akad der Naturforscher. 2 parts.
Verslag van het Verhandelde. 6 parts.
Verslag van P. Hasting, F. A. W. Miguel, en J. van der Hoeven, over heen in hunne handen gesteld.
Verslag (over het Jaar, 1860; Jaar, 1861; Jaar, 1862) Notulen der Algemene en Besturs Verguderingen en Lalenligat.
Verzeichniss der Schlesischen Gesellschaft Breslau. 1861.
Vital Statistics, Contributions to. F. G. P. Neisson.
Victoria Trades Hall and Literary Institute. J. Millar.
Vocabulary of Tasmanian Aboriginals. J. Milligan.
Vögel Neuhollands die Neüentdecken. H. G. L. Reichenbach.
Vorträge über die Florenreiche. C. F. P. von Martius.
Waimakariri River, New Zealand, Second Report upon. W. T. Doyne.
War, Secretary at, United States, Report of. 1866.
Wärme Entwickelung in den Pflangen über die. Dr. Goëppert.
Water, Collection and Storage of in Victoria, Essay on. F. Acheson.
Water Supply of Hobart Town. J. N. Gale.
Water Supply to Liverpool, Proposed. R. Rawlinson, C.E.
Westaustralien und Nordamerika, in veber die Gift-Wiesen. Fraas.
Wind and Current Charts, Murray's.
Wind, On the Direction and Force of at Leopold Harbour. J. Haughton.
Witterung in Nordlichen Deutchland. 1859-60.
Woodcuts, Drawn and Engraved by Greenlanders.
Yarra Flood Commission Analyzed. R. Adams.
Zeitschrift für die Gesammten Naturwissenschaften Berlin. 9 parts.

List of the Institutions and Learned Societies that receive copies of the Transactions of the Royal Society of Victoria.

BRITISH.

Royal Society	London.
Royal Society of Arts	London.
Royal Geographical Society	London.
Royal Asiatic Society	London.
Royal Astronomical Society	London.
Royal College of Physicians	London.
Royal South Horticultural Society ...	London.
Statistical Society	London.
Institute Civil Engineers	London.
Institute of Naval Architects	London.
The British Museum	London.
Geological Society	London.
Museum of Economic Geology	London.
Meteorological Society	London.
Anthropological Society	London.
Linnæan Society...	London.
Athenæum	London.
College of Surgeons	London.
Zoological Society	London.
Geological Magazine	London.
Quarterly Journal of Science	London.
Popular Scientific Record	London.
Colonial Office Library	London.
Foreign Office Library	London.
University Library	Cambridge.
Philosophical Society	Cambridge.
The Bodleian Library	Oxford.
Collegiate Institute	Liverpool.
Public Library	Liverpool.
Mechanics' Institute	Liverpool.
Free Public Library	Manchester.
Literary and Philosophical Society ...	Manchester.
Royal Geological Society of Cornwall ...	Penzance.
Royal Society	Edinburgh.
University Library	Edinburgh.
Royal Botanical Society...	Edinburgh.
Philosophical Society	Glasgow.
University Library	Glasgow.
Institute of Engineers of Scotland ...	Glasgow.
Royal Irish Academy	Dublin.

Trinity College Library	Dublin.
Royal Geological Society of Ireland ...	Dublin.
Royal Dublin Society	Dublin.
Statistical and Social Inquiry Society of Ireland	Dublin.

EUROPEAN.

Geographical Society	Paris.
Acclimatisation Society	Paris.
Scientific Institute	Brussels.
Royal Geographical Society	Copenhagen.
Royal Society of Northern Antiquaries...	Copenhagen.
Academy of Science	Stockholm.
Academy of Science	Upsal.
Royal Society	Upsal.
The University	Christiana.
Imperial Academy	St. Petersburgh.
Imperial Society of Naturalists	Moscow.
Petermann's Geological Journal... ...	Hamburgh.
Society of Naturalists	Hamburgh.
Royal Institution	Utrecht.
Royal Netherlands Meteorological Society	Utrecht.
Geological Society	Darmstadt.
Linnæan Society	Darmstadt.
Geographical Society	Darmstadt.
Academy of Natural History	Giessen.
Geographical Society	Frankfort on Maine.
Royal Academy of Science	Munich.
Royal Academy	Vienna.
Royal Geological Society	Vienna.
Royal Geographical Society	Vienna.
Royal Botanical Society...	Ratisbon.
Imperial Academy	Breslau.
Society for Culture of Science	Breslau.
Society of Naturalists	Leipzig.
Imperial Leopoldian Carolinian Academy of German Naturalists	Dresden.
Royal Society	Berlin.
Geographical Society	Berlin.
Society of Naturalists	Halle.
Society for Natural History	Hannen, Germany.
Physico-Graphico Society	Lund.
Royal Society	Goettingen.
Natural History Society	Geneva.
Royal Academy of Science	Madrid.

Royal Academy of Science	Lisbon.
Society for the Culture of Science and Fine Arts	Bremen.
Office of Public Instruction	Florence.
Academy of Science	Bologna.
Royal Academy of Agriculture and Geography	Florence.
Societa Geographica Italiana	Florence.
Royal Institute of Lombardy for Science, Literature, and Art	Milan.
Academy of Science, Literature, and Art	Modena.
Royal Society of Science	Naples.
Academy of Science	Turin.
Royal Academy of Science	Lucca.
Scientific Academy	Leghorn.
Royal Institute of Science, Literature, and Art	Venice.
Academy of Science	Palermo.

AMERICAN.

American Academy	Boston.
Geographical Society	New York.
Natural History Society...	Boston.
Smithsonian Institute	Washington.
American Philosophical Society... ...	Philadelphia.
Academy of Science	St. Louis, Missouri.
War Department, United States Navy ...	Washington.
Department of the Interior	Washington.

ASIATIC.

Madras Literary Society...	Madras.
The Geological Survey Department ...	Calcutta.
Royal Bengal Asiatic Society	Calcutta.
Meteorological Society	Mauritius.
Royal Society of Netherlands, India ...	Batavia.

COLONIAL.

Parliament Library	Melbourne.
University Library	Melbourne.
Public Library	Melbourne.
Registrar-General's Department... ...	Melbourne.
Medical Society	Melbourne.

German Association	Melbourne.
Mechanics' Institute	Melbourne.
Sandhurst Free Library	Sandhurst.
Philosophical Society	Adelaide, S.A.
Royal Society	Sydney, N.S.W.
The Observatory	Sydney, N.S.W.
Royal Society	Hobart Town.

List of Scientific Gentlemen, not honorary or life members of the Society, to whom the Transactions are forwarded.

General Sabine	Pres. Royal Society, London.
Wm. Dollond, Esq.	London.
The Colonial Secretary	London.
Rev. H. B. Dwight	New York.
Dr. W. F. Suringar	Leyden.
Dr. Buchenau	Bremen.
Dr. Hector	New Zealand.
Mr. Justice Cockle	Queensland.

MEMBERS

OF

The Royal Society of Victoria.

*Those whose names have * or † prefixed, are Life or Honorary Members respectively.*

Aplin, C. D'O. H., Esq., Queensland.
Allan, Alex. C., Esq., The Observatory.
Amess, Samuel, Esq., William-street, Melbourne.

Barker, Edw., Esq., M.D., Latrobe-street East, Melbourne.
Barnes, Benjamin, Esq., Little Collins-street East, Melbourne.
Beaney, J. G., Esq., F.R.C.S.Ed., Collins-street, Melbourne.
Bear, J. P., Hon., M.L.C., Brighton.
Blair, John, Esq., M.R.C.S., Collins street, Melbourne.
Bland, R. H., Esq., Clunes.
Blackburn, James, Esq., Elizabeth-street, Melbourne.
Bonwick, James, Esq., F.R.G.S., St. Kilda.
Boden, Von, F. A. L., Esq., Dartmoor.
Brown, Henry G. L., Geological Survey Office.
*Barkly, His Excellency Sir Henry, K.C.B., The Mauritius.
*Barry, Sir Redmond, Chancellor of the University.
*Bennison, Richard, Sale.
*Blandowski, William, Esq.
*Bleasdale, J. J., Rev., D.D., F.L.S., St. Patrick's College, Melbourne.
*Bosisto, Joseph, Esq., J.P., Richmond.
*Butters, J. S., Esq., M.L.A., Collins-street, Melbourne.

Christy, F. C., Esq., Railway Department.
Clarke, William, Esq., Elizabeth-street, Melbourne.
Corrigan, James, Esq., LL.D., St. Kilda.
Crouch, Thomas J., Esq., St. Kilda.
Crooke, William, Esq., M.R.C.S., Brunswick-street, Fitzroy.
†Clarke, Colonel Andrew, R.E., London.

Dixon, S. E., Esq., Commercial-road, Prahran.
Delisser, Captain E.
Dwight, H. T., Esq., Bourke-street East, Melbourne.

*Denison, His Excellency Sir Wm., K.C.B., Madras.
*Detmold, William, Esq., Collins-street, Melbourne.
*Dobree, Arthur, Esq.
*Darling, His Excellency Sir C. H., K.C.B.

Ellery, R. L. J., Esq., F.R.A.S., The Observatory.
*Eaton, H. F., Esq., The Treasury.
*Elliott, Sizar, Esq., Brighton.
*Elliott, S. T., Esq., Wattle Grove, Richmond.

Ferres, John, Esq., Government Printing Office.
Fitzpatrick, Rev. J., D.D., St. Patrick's College, Melbourne.
Fitzgibbon, E. G., Esq., Town Hall, Melbourne.
*Flanagan, J., Esq., Collins-street, Melbourne.

Gibbons, W. Sydney, Esq., Albert-street, Melbourne.
Goold, Right Rev. Bishop, Melbourne.
Grosse, F., Esq., Collins-street East, Melbourne.
Groves, G. W., Esq., Crown Lands Office, Melbourne.
*Gillbee, William, Esq., M.R.C.S.E., Collins-street East, Melbourne
†Goeppert, H. R., M.D., Ph. D., &c., Breslau.

Haddon, F. W., Esq., *The Argus* Office, Melbourne.
Halford, G. B., Esq., M.D., Professor, The University, Melbourne.
Harrison, Thomas, Esq., Registrar General's Office.
Higinbotham, Thomas, Esq., C.E., Railway Department.
Howitt, Godfrey, Esq., M.D., Collins-street East, Melbourne.
Howitt, Edward, Esq., Collins-street East, Melbourne.
†Haast, Julius, Esq., Ph. D., F.G.S., Canterbury, New Zealand.
†Haidinger, Von, Professor, K.M.T., Vienna.
*Higinbotham, Hon. George, M.P., Temple Court.
*Holmes, George, Esq., New Zealand.

*Iffla, Solomon, Esq., J.P., L.F.P.S.G., Emerald Hill.
Ivey, George Pearce, Esq.

Johnson, William, Esq., Government Analyst, St. Kilda.

*Kay, Captain, R.N., Government House.

Lang, G. S., Esq , J.P.
Lewis, George, Esq., Collins-street East, Melbourne.
Levi, Nathaniel, Esq., Collins-street, Melbourne.
Ligar, Charles W., Esq , Surveyor-General of Victoria.
Linacre, Abraham, Esq., Lygon-street, Carlton.
Lynch, William, Esq., Collins-street West, Melbourne.

Manns, George S., Esq., Carlton House, St. Kilda.
Manton, C. A., Esq., The Treasury.
Marsh, S. H., Esq., Collins-street East, Melbourne.
Marshall, James, Esq., M.A., Queensbury-street, Melbourne.
Moss, Rev. James, Emerald Hill.
Moubray, Thomas, Esq., St. Kilda.
McCoy, Professor F., F.G.S., H.M.C.P.S., &c., The University.
McGowan, S. W., Esq., Electric Telegraph Department.
MacGillivray, P. H., Esq., M.A., M.R.C.S., Sandhurst.
Munday, John, Esq., Clunes.
†Martius, Dr. Von, Munich.
*Mueller, Von Dr. Ferdinand, M.D., Ph. D., F.R.S., Knt., &c., Government Botanist.

Napier, Thomas, Esq , J.P., Essendon.
Neild, J. E., Esq., M.D., Collins-street East, Melbourne.
Newbery, J. Cosmo, Esq., Geological Analyst.
Nicholas, William, Esq., Mining Department.
*Nicholson, Germain, Esq., J.P., Collins-street East, Melbourne.
†Neumayer, Professor George, &c., Bavaria.

O'Shanassy, Hon. John, M.L.C., Colonial Bank, Melbourne.
Officer, S. H., Esq., Swan Hill, Murray.
*Osborne, James, Esq., Merton Lodge, Elsternwick.

Perry, Right Rev. Bishop, Melbourne.
Pegus, William, Esq., Barkly-street, St. Kilda.
Praagst, G. W., Esq., Latrobe-street, Melbourne.
*Palmer, Sir James, President of the Legislative Council.

Rawlings, Thos. H., Esq., J.P.
Rees, David C., Esq., Registrar General's Department.
Richardson, Albert, Esq., Spring-street, Melbourne.
Rudall, J.T., M.R.C.S L., Collins-street East, Melbourne.
Rusden, H. K., Esq., Tivoli Place, South Yarra.
*Rawlinson, Thos. E., Esq.. C.E., Belfast.
*Reed, Thomas, Esq., Collins-street East, Melbourne.
*Read, Joseph, Esq., Elizabeth-street, Melbourne.

Sutton, His Excellency Sir J. H. T. Manners, K.C.B., Governor of Victoria, *Patron.*
Stawell, Sir William, Chief Justice of Victoria.
Sprent, J. S., Esq., Custom House, Melbourne.
*Smith, A. K., Esq., C.E., Leicester-street, Calton.
†Scott, Rev. W., M.A., F.C.P.S., Sydney.
†Smith. John, Esq., M.D., University, Sydney.
†Schultz, Dr. Von, Bavaria.

Taylor, W.F., Esq., M.D., Beechworth.
Tindale, Benjamin, Esq., Grattan-street, Carlton.
Thompson, H.A., Esq., Lucknow, N.S.W.
†Todd, Charles, Esq., Adelaide.

Ulrich. G. H. F., Esq., F.G.S., Survey Department.

Walker, Wm., Esq., Cardigan-street, Carlton.
Waugh, Rev. J. S., St. Kilda.
Willan, Robert, Esq., Queen-street, Melbourne.
Wild, Edward, Esq., Collingwood.
Wilkins, A. G., Esq., St. Kilda.
Wilkins, John, Esq., M.R.C.S., Collins-street East, Melbourne.
Wilkinson, Charles, Esq., Survey Department.
Williams, Wm., Esq., M.L.A., Albert-street, Melbourne.
Winter, J. I., Esq., Colinabbin, Runymede.
Woods, Rev. J. E. T., &c., Adelaide, South Australia.
*Were, J. B., Esq., Collins-street West, Melbourne.
*Wilkie, D. E., Esq., M.D., Collins-street East, Melbourne.
*Wilson, Professor, W. P., &c., The University, Melbourne.
*White, E. J., The Observatory, Melbourne.

Zumstein, H. Esq., Collins-street, Melbourne.

MELBOURNE:
STILLWELL AND KNIGHT, PRINTERS,
COLLINS STREET EAST.

TRANSACTIONS

AND

PROCEEDINGS

OF THE

Royal Society of Victoria.

PART I.—VOL. IX.

Edited under the Authority of the Council of the Society,

BY

THE HONORARY SECRETARY, THOMAS H. RAWLINGS.

THE AUTHORS OF THE SEVERAL PAPERS ARE SOLELY RESPONSIBLE FOR THE SOUNDNESS OF THE OPINIONS GIVEN AND FOR THE ACCURACY OF THE STATEMENTS MADE THEREIN.

MELBOURNE:
STILLWELL & KNIGHT, PRINTERS, 78, COLLINS STREET EAST.
Issued July 1868.

AGENTS TO THE SOCIETY.
WILLIAMS AND NORGATE, 14, HENRIETTA STREET, COVENT GARDEN, LONDON.
To whom communications for transmission to the Royal Society of Victoria from all parts of Europe should be sent.

TRANSACTIONS

AND

PROCEEDINGS

OF THE

Royal Society of Victoria.

PART II.—VOL. IX.

Edited under the Authority of the Council of the Society,

BY

THE HONORARY SECRETARY, THOMAS H. RAWLINGS.

THE AUTHORS OF THE SEVERAL PAPERS ARE SOLELY RESPONSIBLE FOR THE SOUNDNESS OF THE OPINIONS GIVEN AND FOR THE ACCURACY OF THE STATEMENTS MADE THEREIN.

MELBOURNE:
STILLWELL & KNIGHT, PRINTERS, 78, COLLINS STREET EAST.
Issued January 1869.

AGENTS TO THE SOCIETY.
WILLIAMS AND NORGATE, 14, HENRIETTA STREET, COVENT GARDEN, LONDON.
To whom communications for transmission to the Royal Society of Victoria from all parts of Europe should be sent.

Trans

AMNH LIBRARY
100167215